# PROCEEDINGS

OF THE

# Boston Society of Natural History.

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# BOSTON SOCIETY OF NATURAL HISTORY.

TAKEN FROM THE SOCIETY'S RECORDS.

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## Wednesday, June 15, 1870.

Vice President, Dr. C. T. Jackson, in the chair. Forty-eight persons present.

*Voted*, on motion of Mr. C. J. Sprague, to suspend the rules and make the Report of the Nominating Committee first in the order of proceedings.

Mr. Edward Pickering, in behalf of the Nominating Committee, presented the following report:—

The committee appointed at the last meeting of the Society to nominate a President, have attended to that duty, and beg leave to report. The name which first suggested itself to your Committee was that of our first Vice-President, Charles T. Jackson, one of the earliest, most constant and devoted of the friends of this Society. Upon his unwearying interest in its welfare, his liberal contributions to its treasures, his courtesy as a presiding officer, his well-known scientific attainments, it is not necessary, in the presence of this Society to enlarge. We are all witnesses. But the reception of the following letter has prevented the Committee from offering his name as a candidate for the office.

*Boston, June* 13, 1870.

EDWARD PICKERING, ESQ., Chairman of Committee.

*My Dear Sir:*

Having been informed that the Committee on Nomination of President of the Boston Society of Natural History were disposed to offer my name as a candidate for that office, I beg leave through you to say to the Committee, that however highly I consider the proposed honor, I cannot consent to become a candidate, since my health, which is often impaired, especially in the winter months, might be inadequate to the very important duties and constant attention required of the first officer of the Society. So far as my health and ability will permit, I shall always be happy to labor for the interests of the Society, and whatever influence I can exert will be in its favor.

A younger man than myself, I believe, would be able to serve the Society as President much better than I can, and my personal preference would be in favor of the promotion of the second Vice-President, Mr. T. T. Bouvé, to the Presidency of the Society.

Most cordially thanking the Committee for their favorable consideration, I have the honor to be,

Your Obt. Servt.

CHARLES T. JACKSON.

I am under these circumstances instructed by the Committee to propose for the office of President of this Society, the name of our second Vice-President, Thomas T. Bouvé.

E. PICKERING, for the Committee.

Boston, June 15, 1870.

It was then moved by Dr. C. F. Winslow that the report be accepted, and that the Society proceed to ballot for the candidate presented by the Nominating Committee.

Dr. J. B. S. Jackson moved, as an amendment, that the ballot be postponed to a meeting to be held on Wednesday next, of which notice shall be given in the newspapers on the Monday and Tuesday preceding, and on Wednesday, the day of the meeting.

Dr. D. H. Storer moved, as a second amendment, that the ballot be postponed to the first meeting in October.

The amendments were rejected, and the motion of Dr. Winslow prevailed.

The ballot was ordered. Dr. J. C. White and Mr. B. P. Mann were appointed scruteneers. They announced as the result that thirty-three votes had been cast, thirty-one of which were for Mr. Thomas T. Bouvé, and he was declared elected.

The Secretary read a list of nominations for membership.

The following communications were presented: —

## On the Osteology of the Anterior Vertebræ in Doras niger, with a Comparison of the Structure of the Dorsal Fin in Doras and Balistes.[1] By Richard Bliss, Jr.

In the preparation of the present paper I have limited myself to a discussion of the above mentioned subjects, in the hope of being able at some future day to prepare, with appropriate illustrations, a monographic work on the Osteology of the Doradidæ. Hence the consideration of the osteology of the head, shoulder-girdle, pelvis, etc., has here been omitted.

The tendency of the anterior vertebræ to coalesce, so peculiar to the cartilaginous Sturgeons and Plagiostomes, is also manifested in some of the osseus fishes, it being particularly noticeable in *Fistularia*, *Dactylopterus*, many Cyprinoids, the Siluroids and allied families.

In *Fistularia* the four anterior centrums are greatly elongated and anchylosed, their parapophyses unite to form a continuous lateral ridge on each side of the centrums, and the neural spines form a similar ridge above them.

In *Dactylopterus* the first four centrums are united into a tube sustaining a solid wall above, formed by the union of the neural and interneural spines.

[1] Having been engaged in the study of fishes, under the direction of Professor Agassiz, at the Museum of Comparative Zoology, for several years, I have had ample opportunity of studying the different modifications of fin-structure in the various genera of Siluroids and Doroids, the collection brought by Professor Agassiz from Brazil being exceedingly rich in the genera and species of these families, to which valuable material I have had free access during the preparation of this paper.

In the Cyprinoids the three anterior centrums are soldered together. The parapophyses arising from them exhibit a modification of structure quite remarkable. The coalesced neural spines are much developed, but the interneurals are small, and exhibit no striking peculiarities.

But it is in the Siluroid and its allied family, the Doradidæ, that this enlargement of the centrums, and the modification of their apophyses and spines is carried to its greatest extent. In these groups the centrums are so firmly united that the sutures are almost obliterated. The neural and interneural spines are often so thoroughly united as to form a solid wall extending from the centrum to the nuchal plates, separating the right and left halves of that portion of the body above the vertebral column. The parapophyses of these soldered vertebræ present the most diverse forms, sometimes appearing as porous, rounded prominences, as in *Doras niger*, at other times uniting and forming a broad shield projecting from the sides of the coalesced centrums, as in *Perinampus typus.*

Intimately connected with this extraordinary condition of the vertebral elements, are the modifications which we observe in the osseous rays of the dorsal fin of these fishes. The lateral apophyses of the interneural spine supporting the first fin rays, not only serve as articulating surfaces for the bases of the rays, as is ordinarily the case, but spread out into dermal plates, which unite together in a singular manner to form a nuchal shield, to which Cuvier gave the name of "*bouclier*."[1]

In *Doras niger* the united anterior vertebræ are four in number, the first three exhibiting modified parapophyses; in the third is seen the first indication of a costal organization.

The first centrum is quite small, and is closely united to the basilar bone by a serrated suture. Its small, thin, neural spine rests anteriorly against the prolonged occipital crest; posteriorly it is united to the first neural spine of the next vertebra, and there rising half way to the shield covering the neck, meets the point of the first interneural spine.

[1] For a detailed description of the fin structure in the various families of fishes, I would refer to a series of papers by Dr. Rudolph Kner, "Ueber den Flossenbau der Fische," published in the Sitzungsberichte der Kaiserliche Akademie der Wissenschaften Wien, Vols. XLI, pp. 804-824. 1860; XLII, pp. 232-260, 1860; XLIII, pp. 123-152, 1861; XLIV, pp. 49-80, 1861.

This interneural spine, which is small and thin, expands at its upper extremity into a thick, superiorly arched plate which forms a part of the nuchal shield. Anteriorly this plate is united by sutures to the supraoccipital and parietal bones. Posteriorly it is embraced by the two anterior branches of the dermal plate belonging to the second interneural spine. Cuvier, Meckel and others, have described this plate as a lateral expansion of the top of the first interneural spine, affirming that this spine had no corresponding fin ray. This seems to me, however, to be incorrect, for this plate, although in many species closely united to the interneural spine, appears to be, in reality, a modified dermoneural spine — the first spine of the dorsal fin,— thus altered from its normal form to constitute a part of the defensive armor of the neck. An examination of our common *Amiurus catus* tends to confirm this view; for in that species the homologue of this plate is not soldered to the upper end of the interneural spine, but rests loosely upon it; showing that it is a distinct bone.

This plate, above described, exhibits every variety of form in the different members of the Doras and Siluroid families. In some it is very large, and forms a prominent bone in the nuchal shield. In others, as in *Oxydoras*, it is a slender, lozenge-shaped piece intercalated between the supraoccipital and the large plate of the second interneural spine. In many Siluroids it is removed from the cranial bones, uniting only with the supraoccipital at its posterior extremity. This is the case in *Perinampus typus*. In *Amiurus catus* we find it reduced to its minimum of development, and hidden under the thick skin of the body.

The second centrum is six times as long as the first, and carries an anterior and posterior pair of parapophyses, not united together at their bases, as is the case in many Siluroids. The anterior pair of these apophyses consist of thin, vertically expanded plates, arising in common from the centrum and the neural spine above, and expanding at their extremities into porous spatulate discs, to which the anterior portion of the air bladder is attached. Ordinarily in the Siluroids the extremities of these apophyses are not thus modified, but unite by synarthrosis with the suprascapula. Between the centrum and the bases of these apophyses are found, on each side, three small curiously shaped bones united to one another and to the centrum by ligaments. Posteriorly these bones afford attachment to a portion of the investing sheath of the air bladder. The anterior

portion of the larger bone passes through an opening in the basi-occipital into the cavity of the cranium. These bones have received the name of "the bones of Weber," in honor of Weber, who first described them, and who homologized them with the bones of the ear in mammals. Owen, in his "Anatomy of the Vertebrates" (Vol. I, p. 344, *et seq.*), shows them to be a part of the auditory apparatus, connecting the acoustic labyrinth with the air bladder. Owen says Weber mistook the relation of analogy for one of homology when he named them malleus, incus, and stapes.[1]

The posterior pair of parapophyses consist of small and thin triangular plates rising outward and upward, for a short distance, from the centrum.

In the first centrum of *Doras niger* the hæmapophyses exist as downward prolongations of the centrum, forming a deep furrow in its inferior surface. In the second centrum the furrow is closed for nearly its entire length by the union of the hæmapophyses. In the third and fourth centrums the hæmapophyses form a furrow, as in the first, which exists also in the two following centrums, though much less distinctly marked. Hence the hæmapophyses form a continuous furrow on the under surface of the coalesced centrums, but unite in the second so as to form a tube.

The second centrum has not only two pairs of parapophyses, but also two neural spines. The first neural spine of this centrum (the second spine of the vertebral column) starts from the anterior portion of the centrum, above the anterior parapophyses, and rising upward and backward, meets the downward prolongation of the second interneural spine, to which it is firmly united. This interneural spine has two outstanding lateral wings; these expand superiorly, and uniting form a single broad and arched dermal plate,

[1] This view of Weber was strongly opposed by Geoffroy St. Hilaire, who considered these bones to be the modified ribs of the first, second and third vertebræ. Meckel was inclined to agree with Weber in considering them the homologues of the bones of the ear. Saagmans Mulder described the bones as a part of the auditory apparatus; believing the air bladder to be identical with the tympanic membrane. Later, however, he came to the conclusion that the bones considered by Weber as malleus and incus, were but ribs; and the stapes as transverse apophyses of the first vertebra. Brechet believed them to belong to the auditory apparatus, and Valenciennes considered them as special bones. Baudelot reviews the subject at some length in "Comptes Rendus" for 1868, pp. 330-334 and comes to the conclusion that these bones represent the superior arches of the first and second vertebræ the inferior arch of the third, and the *os intercrural* parted in two.

which covers the neck immediately in front of the dorsal fin. The anterior, posterior and lateral margins of this plate are concave, forming a pair of arm-like projections in front and behind. The anterior arms partially clasp the plate, which I consider to be the first dermoneural spine, and unite by suture with the two parietals and with the posterior angles of the suprascapular bones. The posterior arms embrace the second dermoneural spine, and are firmly united to the two lateral apophyses of the third interneural spine.

Behind the plate just described rises the second dermoneural spine; but so modified that its true nature as a fin-ray is not at first discernible. A smooth bony projection or keel rises from the top of the second interneural spine, behind and somewhat beneath the roof formed by the last described dermal plate. This keel, which is somewhat sharply ridged and rounded anteriorly, supports the second dermoneural spine. This spine is a short, triangular, forked bone, anteriorly convex and posteriorly concave. When in position it rides upon the keeled crest, and is hidden beneath the skin surrounding the fin. Its posterior edges give attachments to ligaments connecting it with the third dermoneural spine, and a pair of muscles extend from the arms of the rider to the anterior edge of the articulating facet of the third interneural and to a portion of the dermal plate above. From the anterior face of the rider, just above the fork, arise two muscles which are attached to the inner surface of the dermal plate immediately in front of the spine. These two sets of muscles serve to move this spine up and down upon the keel, by which the large spine behind it is raised and lowered as will be described hereafter.

The third neural spine rises above the second pair of parapophyses belonging to the enlarged centrum, and meets, and is united to the interneural above, in the same manner as is the one before it. It is also united to the neural spines before and behind it. In fact, the neural and interneural spines of the second, third and fourth vertebræ are so soldered together as to form a wall almost entirely dividing the space above the vertebræ.

The lateral ridges of the third interneural spine expand superiorly into two lateral apophyses modified into dermal plates. The anterior edges of these apophyses are united to the posterior arms of the plate in front of them; posteriorly they extend downward and outwardly, and terminate in an obtuse point.

On each side of the fin the top of this third interneural spine is

formed into an articulating facet, upon which rest the two lateral branches of the third dermoneural spine, and which are kept in position by a pair of muscles extending from the outer edges of the facet to the posterior edges of the arms of the spine. The bone between the facets is hollowed out for the reception of the downward projection of the middle portion of the spine. This spine, the third dermoneural, is very large and thick, and has on its anterior edge a row of stout conical teeth. The posterior edge of the spine is furrowed and likewise furnished with teeth, but smaller than those in front. The base of this spine is widened and perforated through its centre in an antero-posterior direction. The head of the interneural beneath is united without suture to the second interneural, and to the basal portion of the second interneural crest, and projecting backward as a slender, bent rod, passes through the perforation in the base of the fin-spine, and uniting with the interneural again behind the spine, forms a kind of linked joint. I believe that this kind of joint is formed by the inward projection of the arms of the spine through the crest upon the head of the interneural, and not by an antero-posterior prolongation of the crest through the base of the spine. My reasons for this belief will be made evident in my description of the first dorsal fin of Balistes, (see p. 10), where it will be seen that though the interneural crest is completely perforated, the arms of the spine do not pass entirely through it. This peculiar mode of articulation is found in the fishing filaments upon the head of *Lophius piscatorius*, in which species the spines of the dorsal fin are modified into long filaments to serve a special purpose;[1] and whose extreme mobility is secured by the kind of articulation I have just described. In the ordinary forms of fin spines, the prolongation of the head of the interneural, which passes through the base of the dermoneural spine behind it, does not unite with the interneural belonging to the spine through which it passes. But in the Siluroids, as well as in *Lophius* and *Balistes*, the use to which the spine is put necessitates this linked-joint mode of articulation.

The mechanical operation of this complicated apparatus is as follows: the enlarged spine of the fin being used as a weapon of offense, the union of the neural and interneural spines with each other

[1] See, Description des filets pêcheurs de la Baudroie, par M. Bailly, Annales des Sciences Naturelles, 1er, Ser., Tom. II, 1824, pp. 323-332; and also, Analogie des Filets Pêcheurs, etc., par Geoffrey St. Hilaire, Mémoires du Muséum d'Histoire Naturelle, Tom. XI, 1824, pp. 132-142.

and with the dermal plates, serves to give the necessary support to the apparatus. When the fish would erect the spine of the fin, the muscles attached to the anterior face of the little forked bone or rider, contract, pulling the bone forward and downward on the rounded crest of its interneural. The articulating facet, upon which rest the arms of the large spine, acting as a fulcrum, the ligaments which pass from the posterior edge of the rider to the base of the spine, cause it to rise with the forward and downward movement of the rider. When erect, the spine cannot be lowered by pressure upon it from above; any attempt to thus depress it serves only to pull the rider more closely against the crest which now stands between it and the large spine. By this means the fish is enabled to inflict so severe a wound as to render him a formidable antagonist. In order to lower the spine, the muscles connecting the arms of the rider with the anterior edge of the articulating facet contract, pulling the rider up the crest, which, at the same time, allows the large spine to be lowered by appropriate muscles attached to the posterior edge of its arms.

Geoffroy St. Hilaire, in his paper on the analogy of the fishing filaments of *Lophius piscatorius* with the first rays of the dorsal fin in the Siluroids, published in the Mémoirs du Muséum d' Histoire Naturelle (Tom. XI, p. 132), gives a detailed account of this fin apparatus, and there shows for the first time, that the little forked bone, which had escaped the notice of former naturalists, is truly a spine of the dorsal fin. He describes it, however, as the *first* spine of the fin, while, as previously mentioned, I am led to regard it as the *second*; believing that the dermal plate supported by the first interneural is really the first spine.

Cuvier, also, in his "Anatomie Comparée" (Tom. I, p. 126), alludes to this peculiar articulation of the large dorsal spine in the Siluroids; and in his Valenciennes and "Histoire Naturelle des Poissons" (Tom. XIV, pp. 310-322), gives a very brief description of this fin structure in the diagnosis of the family of Siluroids.

The third anchylosed centrum is quite short, not much larger than the first. Its neural spine is broad and short, and unites with the neural spines in front of and behind it, as well as with the interneural spine belonging to the first branched ray of the dorsal fin. The parapophyses of this centrum consist of large, porous, rounded excrescences, affording attachments to the posterior portion of the air-bladder. They are true apophyses, and near their bases afford

support to a pair of very stout ribs. A long, and rather thick bone extends from the extremity of each of these ribs to the posterior point of the dermal plate of the third interneural spine. This bone, which is serrated externally, forms one of the series of keeled dermal scutes which run along the side of the body. It is much larger than the others, and its apparent office is to afford support to the scutes. In *Oxydoras*, the porous apophyses above described are wanting, though the large ribs are present.

In *Doras* the hæmapophyses of the third vertebræ are not closed beneath the centrum.

The fourth anchylosed centrum is somewhat larger than the third, and differs from it in exhibiting normal parapophyses with ribs of the ordinary form. Its neural spine is united loosely to the neural in front, and to the interneural of the second branched ray. As in the third centrum, the hæmapophyses do not unite.

In the Doradidæ the different members of the coalesced vertebræ, and the interneural spines of the dorsal fin are so soldered together and modified, that it is exceedingly difficult to distinguish them. A comparison of *Doras* with *Perinampus typus*, however, will aid in determining the relations of the neural and interneural spines in *Doras*. For in *Perinampus* the interneural plates are so separated from the bones of the cranium, and the spines themselves so slightly united, that it is quite easy to trace them. But in *Perinampus* the parapophyses of the coalesced vertebræ differ widely from those of *Doras*, for they are not separate as in this latter species, but unite to form a broad, flat, scale-like bone, projecting laterally from the centrums, and bearing, as Meckel has said, a striking resemblance to the carapace of a chelonian.

In connection with the structure of the dorsal fin in *Doras*, it will be of advantage to make a comparison with the fin apparatus of the first dorsal of *Balistes*, which, in some points of structure, resembles that of *Doras*.

In *Balistes* the apparatus which supports the first dorsal fin consists of a number of bones, — the interneurals, — soldered together into a boat-shaped piece which is attached anteriorly by ligaments to the occiput, and supported posteriorly by a bony rod resting against the fourth neural, and the first interneural spine of the second dorsal fin. This little boat has a deep keel, formed by the union of the two sides. An oval, longitudinal opening in the sides of the boat in its anterior part, affords exit for the two arms of the second spine of

the fin. A prolongation of the upper anterior edge of the sides of the boat extends downward to the keel below the middle of the length of the oval opening. The anterior portion of the keel is somewhat prolonged, and fits into an opening in the occiput, by which additional support is afforded to the apparatus.

This naviculate bone bears three spines; two of them, one immediately succeeding the other, are peculiarly articulated with the bone which supports them. The third spine is placed at the hinder extremity of the boat, on a bone, which, though soldered to the bone bearing the two anterior spines, is yet distinct from it, as is shown by the direction of its fibres. A tendon, the use of which will be described presently, extends from the upper part of this third spine to the base of the second.

The first spine is stout and roughened on its anterior face with small, blunt teeth. The posterior face of the spine is deeply grooved, and the two edges of the groove somewhat approach each other to form a kind of shoulder, which, when the spine is erect, rests upon a projection on the anterior face of the second spine. The portion of the first spine which rests upon the thickened prow of the boat expands on each side, and the bases of these expansions are formed into articulating surfaces, and rest upon corresponding facets on the bone beneath. Between the articulating facets of the naviculate bone, rises a little crest, hollowed so deeply on each side as to form a complete perforation. Into these hollows project two inward prolongations of the lateral articulating arms of the spine. But these inward prolongations of the arms *do not meet through the perforated crest.* It is, as will be seen, an approach to the linked joint mode of articulation described in *Doras.*

The second spine of the fin, which is smaller than the first, is forked at its base, and bestrides a small crest formed by an upward extension of the keel of the boat. The two arms of the spine are prolonged downwardly, as previously stated, through the oval opening in the sides of the boat, and are supported movably at the point where the bony rod from the anterior edge of the boat is joined to the keel, below the opening in the side of the boat. The anterior face of the spine is provided with a protuberance just above the fork, upon which rests the shoulder of the large spine in front.

In *Balistes*, as in *Doras*, the large spine is used as a weapon, and like that of *Doras* cannot be lowered till the other spines are moved. When the spines are raised the second spine rides forward over its

crest and fits closely under the shoulder of the large spine in front of it. The third spine is also raised by the tendon connecting it with the second. When erect, any pressure upon the large spine forces its shoulder against the protuberance on the second, which is supported by its crest and by the extremities of its arms, so that a backward movement of either of the spines is impossible, and the large spine is rendered serviceable as a weapon. If now the third spine be pushed down, the tendon which connects it with the second causes this latter to rise and ride over its crest, which thus allows the first spine to be readily depressed by appropriate muscles attached to its base.

The operation of this peculiar apparatus much resembles that of a lock of a gun, and has given to the fish its common name of "trigger" or "cock fish."

Thus it is seen that the principle of the working of this apparatus is the same as in *Doras*, though the means by which it is accomplished are somewhat different. In *Doras* it is the third spine which is enlarged to serve as a weapon; while in *Balistes* it is the first. In *Doras* the large spine maintains its erect position by pulling the small spine in front of it against its crest. In *Doras* only two spines compose this weapon, the first of which must be moved before the second can be; in *Balistes* three spines enter into the structure of the apparatus; the third to be moved before the position of the other two can be altered. Equal support is obtained in both; but in the one case resistance results from a pulling movement from behind; and in the other from a pushing movement from before.[1]

[1] For further information regarding the fin structure of *Balistes* and allied families see Hollard's Monograph of the *Balistidæ* in Annales des Sciences Naturelles, Vol. XX, 3me Ser., p. 101, 1853; Meckel's description of *Balistes* in his System der Vergleichenden Anatomie, Theil II, pp. 239-242, 1824; Bruhl's "Osteologisches aus dem Pariser Pflanzengarten, p. 58, et seq. and L. Agassiz' Poissons Fossiles, Tom. II, Pt. 2, p. 249.

## Embryology of Isotoma, a Genus of Poduridæ. By A. S. Packard, Jr., M.D.

The eggs were found laid singly or in masses on the damp under surface of the bark of an apple tree. They are spherical, white, with the chorion very transparent, and measure .0625 of an inch in diameter. On the 25th of April many of the young had hatched out; they continued to hatch until the 6th of May.

In none of the eggs was I fortunate enough to observe the segmentation of the yolk, nor the formation of the blastoderm. Numerous eggs, however, were observed, in which the blastoderm had not yet been formed. In these, amid a mass of minute cells, floated four large fat cells, measuring about one-fourth the diameter of the egg itself, with numerous smaller cells measuring about one-fourth the diameter of the largest cells just mentioned. The earliest stage observed was that when the blastoderm has been resolved into the primitive band. (Fig. 1.) At this time the primitive band becomes infolded, indicating the cephalic lobes of the head. In a succeeding stage (Fig. 2) the antennal, mandibulary and 1st maxillary segments, and the three thoracic segments are indicated. The formation of the germ thus far closely resembles that of the Phryganeidæ, as described and figured by Zaddach.

The next change is the closure of the body walls over the yolk, and the appearance of the rudiments of the appendages, and the cephalic lobes. At this time, also, the somewhat bilobate end of the abdomen is formed, and also the rudiments of the future "spring," consisting of a pair of tubercles, larger at this period than the rudimentary antennæ. This fact is interesting, as I have observed in other insects (*Bombus*, *Vespa*, *Cicada*, *Aschna* and *Agrion*) that these were sternal outgrowths, and not articulated, and therefore, as I supposed, not homologous with the legs and jointed appendages of the head. This spring, therefore, partially represents the ovipositor of the higher insects, the ovipositor originally consisting of three such pairs of tubercles. At this period the "amnion" or "parietal embryonal membrane," appears as a tough membrane surrounding the embryo.

In a succeeding stage the intestine is formed, and the rudiments of the antennæ and legs have greatly increased in size. Still later the appendages begin to show traces of articulation, and the

tip of the abdomen is deeply cleft by the median furrow of the body. The rudimentary mandibles and 1st maxillæ are distinct; the cephalic lobes appear very distinct, and the antennæ are nearly twice as large as the legs. I was unable, after careful and repeated endeavors, to discover at this or any other period, any traces of the 2d maxillæ (labium) though they may be found on more careful examination hereafter, as they are present in a very rudimentary form in the adults, and are large and well developed in the Lepismatidæ.

A later period still (Fig. 3, 3*a*) is characterized by the differentiation of the head as a distinct region of the body; the posterior portion, including the mandibular and 1st maxillary segments, uniting with the cephalic lobes, in which the eyes (each now consisting of eight ocelli) are situated. The antennæ are now of much the same shape as in the larva, while the epicranium, clypeus and labrum are differentiated, and the "spring" is fully formed, consisting of a pair of finger-shaped, three jointed appendages, the basal joints consolidated into a single tubercle, from which the extremities diverge.

Another well marked stage, *i.e.*, just previous to the hatching of the embryo, is signalized by the mandibles and 1st maxillæ becoming acute, closely appressed to one another and to the under side of the head, and withdrawn within the head, so that the mouth is somewhat tubular, as it appears in a front view of the head. At this period, also, the absence of any apparent traces of a labium is worthy of notice.

The embryo throws off the chorion and amnion in a moment, and the larva is very active in its movements. The larva is white, becoming after a second moult of a purplish hue, while the adults are snuff brown. The larva is much shorter and thicker than the adult, and the spring is very short and stout, while the head is much rounded, and the antennæ are short, and thick, and very large. In fact the larva repeats the general form of *Podura*, *Achorutes* and *Lipura*, while the adult is more closely allied to *Degeeria*. The species, which is undescribed, is named *Isotoma Walkerii*, and belongs to Nicolet's first section of the genus, of which the European *I. glacialis* is a type.

The development of this insect is throughout very similar to that of the Phryganeidæ; the germ, as in that neuropterous family, being developed on the outside of the yolk. The parietal membrane

was distinct, but the inner or visceral membrane, which exists in the Phryganeidæ, was not observed.

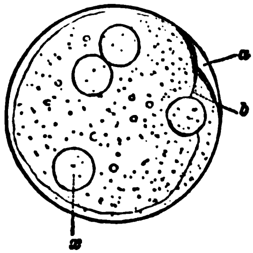

Fig. 1.

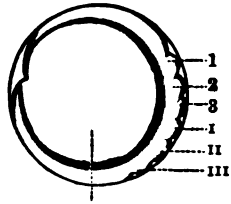

Fig. 2.

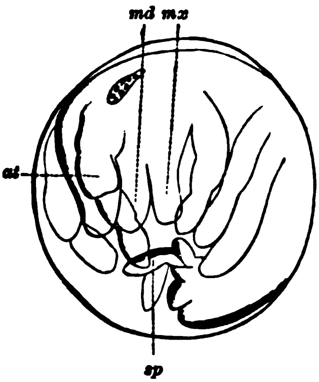

Fig. 3.

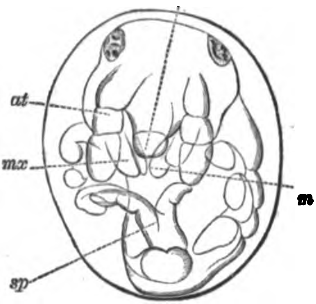

Fig. 3a.

*Explanation of the Figures.*

Fig. 1, egg with the primitive band lying on the outside of the yolk; *a b*, fold indicating the meeting of the cephalic and abdominal end of the germ; *x*, large yolk cells.

Fig. 2, the primitive band, with the rudiments of the cephalic (1, 2, 3) and thoracic (I, II, III) segments.

Fig. 3, side, and 3*a*, front view of the embryo; *at*, antennæ; *md*, mandibles; *mx*, maxillæ; *sp*, spring.

The Rev. C. F. Knight presented to the Society a collection of shells and skulls of various turtles made by him in Florida, during the past winter, and offered some remarks on the habits of the animals.

He described the construction of the burrow which the *Testudo polyphemus* [*Xerobates Carolinus* Agass.] (Gopher) makes, digging a gallery often sixteen feet long, and sinking to the depth of twelve feet, with several chambers branching from it. These are not unfrequently occupied by a curious collection of probably unwelcome guests. On one occasion, a pair of opossums, a raccoon, a rattlesnake more than six feet long, and two other snakes, beside several of the native black rats of the district, were taken from one of these holes. Mr. Knight spoke of the enormous strength of this land tortoise, one of them carrying a full grown man on his back with apparent ease, and of their curious uneasiness if the slightest rain fell upon their thick shells.

The *Trionyx ferox* [*Platypeltis ferox* Fitz.] is found in great numbers in the lakes of middle Florida. It is remarkable as having a leathery integument upon its back and belly, which are only very partially covered with a bony structure, and feet which resemble more the flippers of the sea turtle than the limbs of those found in fresh waters. The *anus*, in the female, is almost at the extremity of a wide and fleshy tail. The jaws, serrated, and of great strength, are covered with a pendulous upper lip. The nostril is greatly prolonged, suggesting at first sight the proboscis of an elephant, and it was observed, while the creatures were living in captivity, that they always swam with only the extremity of this nostril exposed above the surface ; while most turtles lift the whole top of the upper shell above the water. This soft shelled creature being a favorite food both of man and various fish-hawks and eagles, it was conjectured that this formation of nostril enabled the creature to keep submerged beneath the turbid water and out of sight of its watchful enemies.

The *Emys serrata* [*Trachemys scabra* Agass.] in the early summer congregates in great numbers in the shallow parts of certain lakes, and the warm and still bayous near the mouths of those streams which empty into the Gulf. On one occasion the speaker, floating quietly down stream, came upon one of these gatherings where there seemed

to be many thousands within the space of two or three acres, covering every log and stump and hummock almost as thickly as shingles lie upon a roof.

The *Emys Floridana* [*Ptychemys concinna* Agass.] is found in brackish waters near the Gulf. It has upon its fore feet three claws of ordinary length, and two of an enormous development; they being often found nearly three inches long. The reason of this elongation was not apparent, until by close observation from a boat at the mouth of the river Wakulla, the speaker saw two turtles of this species, thrusting these long claws into the holes made by some worm, with which the hard clay bottom of the stream was everywhere perforated. The transfixed worms were probably the common food of this turtle.

The *Chelonia Mydas* (common green turtle) is said by the turtle-fishers to enter the creeks which abound on that coast, and having eaten its fill of the sea-grass growing there, to roll together masses of it, of the size of a man's head, which it cements with the clay on which the grass grows, and then when the turn of the tide takes it out to sea, follows it, feeding upon it. When, therefore, the fishermen find any of these balls floating down from a creek, they at once spread a strong net across the mouth and almost always secure a number of these turtles.

After referring to the large size of the Loggerhead, *Thalassochelys caouana* Agass., Mr. Knight called attention to the shell of an exceedingly pretty little turtle which inhabits the deep, cold springs of upper Florida, *Thyrosternum Pennsylvanicum.* When inhabited by the living animal it is covered with a light green, hairy substance; but whether of an animal or vegetable character he could not decide.

Mr. Knight closed his remarks by saying that this part of Florida, near Tallahassee, with its high clay bluffs and its broad pine plains, was an exceedingly rich field both for the zoologist and the archæologist.

Mr. Putnam remarked that Mr. Knight's communication contained several important and interesting observations on the habits of the several species of turtles on the table, and much that had never been published.

The habits of the young Gopher (*Xerobates Carolinus*), as described by Mr. K., were interesting, as showing a marked

difference between the habits of the young and old of the same species.

The "green hair" noticed by Mr. K. as found on the small water turtle (*Thyrosternum Pennsylvanicum*) was a confervoid growth common on the many species of fresh water turtles, and especially on the members of the family *Cinosternoidæ* and other species living mostly in stagnant water.

The observations on the use of the long nails of the feet of *Ptychemys* he considered as a most important and interesting fact added to our knowledge of the habits of turtles, and as another most interesting example of the adaptation of structure to habits.

Mr. B. P. Mann spoke of carbolic acid as a preservative. He had used two preparations successfully, viz.: 1st, 1 part carbolic acid to 150 parts water. 2d, 1 part carbolic acid to 57 parts water. Mr. Scudder had informed him that the stronger was the better preparation for the preservation of the larvæ of insects.

Prof. N. S. Shaler presented the following papers by title: "On the Progress of Life on the several Continents," and "On the Geological Structure of the Wachusett Range."

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October 5, 1870.

The President, Mr. Thomas T. Bouvé, in the chair. Twenty-three persons present.

Messrs. Samuel How, Frank D. Millet, Edward S. Shaw and Albert H. Tuttle of Cambridge, Caleb Cook and James H. Emerton of Salem, Daniel T. Letteney and Charles A. Walker of Chelsea, Rev. Caleb D. Bradlee, Prof. Alfred P.

Rockwell, C. F. Lyman, Wm. Norton Bullard and Arthur W. Willard of Boston, were elected Resident Members.

Dr. Thomas Dwight, Jr., exhibited some flexible dissections prepared by him, and made the following remarks on the preservation of anatomical specimens:—

It has always been a great objection to the dried dissections which abound in anatomical museums and are much used for instruction, that they give by no means a true idea of the parts. The branches of the arteries and nerves are there, but their relations to the neighboring parts are lost, and the muscles so shrunken as for the most part to be unrecognizable. In short, such preparations are caricatures, not representations of nature. In May, 1869, I saw in the Musée Orfila, at Paris, some admirable preparations of extremities bearing the label "Procédé de Brissaud et Lascowski," in which the muscles, instead of being shrivelled cords, were of natural shape and size, flexible, and in some cases quite red. Motion in the joints was almost perfect, and the arteries and nerves bore their original relations to the other structures.

I declined Dr. Lascowski's offer to sell me the secret by which they were prepared, and have endeavored to discover it. With the exception of the color, the results have been very satisfactory, as shown by many specimens, some over a year old. One part of carbolic acid to five of glycerine preserved the shape and flexibility admirably, but the color was very dark. Perhaps the best preparation is one of a forearm and hand, dissected to show the muscles, arteries and nerves. This was preserved by a mixture made by throwing an excess of two parts chloride of sodium and one of nitrate of potash, into six parts of glycerine and one of alcohol. This preparation has the disadvantage that there is danger of mould if the specimen be at all exposed to damp, which is not the case when carbolic acid has been used. Preserved specimens of this nature will probably be of great value in the study of Comparative Myology.

In a paper read at the Annual Meeting of the Massachusetts Medical Society, in 1870, I have given a more minute account of the process and of the various mixtures employed.

Dr. J. B. S. Jackson spoke of the importance, in an educational point of view, of these flexible preparations, and

thought similar preparations of the internal organs might be made. He doubted if any of these solutions would preserve colors permanently, but if a preparation could be discovered which would preserve the form perfectly, he would be willing to dispense with color.

The following papers were read:—

LETTER FROM DR. C. F. WINSLOW, CONTAINING A DESCRIPTION OF A DEEP EXCAVATION IN THE VALLEY OF THE RHINE, NEAR THE MOUTH OF THE NECKAR, AND OF A MORTAR-SHAPED PEBBLE FOUND TWENTY-FIVE FEET BELOW THE SURFACE.

HEIDELBERG, BADEN, March 31, 1868.

This afternoon I walked with my friend, Mr. William H. Wahl,[1] of Philadelphia, a scientific student at the University here, to show him a deep excavation or gravel pit in the flat valley of the Rhine, and give him some idea of the water action by which these valley deposits have been made. The spot which we explored is on the road to Schwetzengen, and is about one mile, or one and one-half miles from the base of the mountain south of the Neckar. The gravel pit is a short distance west of the railroad crossing, and on the south side of the road, or common highway.

The deposit consists of:

1. Silt, fine and dark yellow, with many helices irregularly interspersed, and some small pebbles rounded and angular, extending in irregular, horizontal lines or laminations, with two or three large, angular, or partially rounded stones, or boulders of granite and red sandstone, similar to the granite and red sandstone existing in the Neckar valley. (The silt is of the same character as that composing in many places the surface of the valley of the Rhine, and which crops out on the north banks of the Neckar, and which I have observed constituting banks of considerable thickness on the flanks of the hill, both north and south of the Neckar valley, and in the Neckar valley east of Heidelberg.) This deposit varies from two to

[1] Mr. Wahl soon after graduated at Heidelberg with the first honors of that University, and is now (Aug., 1870) a Professor in the Franklin Institute, and an Associate Editor of the Journal of the Franklin Institute, Philadelphia.

six feet in thickness, according to the irregularity of the surface of the field.

2. Rounded pebbles and stones of all sizes, mixed with some angular ones, composed of granite, red sandstone, muschelkalk, etc., lying in lines or layers at irregular inclinations to each other, as if constantly cut out and disturbed and redeposited by tidal currents of different degrees of strength. Large angular boulders and fine silicious sand are here and there interspersed in this gravelly deposit. This varies also from ten to fifteen feet in thickness, with irregular edges of connection with the deposits above and below it.

3. A layer of fine silicious sand fit for mixing with mortar, containing few pebbles and presenting a front or outcrop which shows the sand to have been constantly shifting by the action of wind or water (water without doubt as it appeared to me). This is from one to two and one-half feet in thickness.

4. Another deposit of pebbles, stones, boulders, etc., as described in the second deposit. The excavation reaches down no further than about thirty or thirty five feet from the surface.

We found two German laborers (peasants), at work there in sifting this material for mortar sand and building purposes. Perceiving us interested in examining the place and in breaking the stones, they showed us what they called "a curious looking stone," which they had just taken out where the deposit No. 3 joins No. 4. The stone was still saturated with moisture, and looking very dark, as wet red sandstone does look, and sand and small pebbles were still adhering to it as if loosely cemented to it by long contact. I purchased it of them believing it to be an implement in the domestic economy of some extremely ancient representatives of the human race. The spot where this object was found was twenty five feet from the surface of the field as carefully examined and estimated by Mr. Wahl and myself.

The implement appears to be a red sandstone *mortar* (like our North American Indian mortars) 3 3-4 inches in diameter, and 1 1-2 in depth, and 3-4 of an inch in the thickness of the shell—or about these dimensions. The object is concave and convex, with rounded edges, smooth and evenly rubbed and worn on the inside like any mortar in long use, and roughish on the outside as if weather worn or knocked about by hard usage. The mark of the pick is visible on the convex part where it was struck when it was dislodged from the deposit in which it was embedded. The laborers informed us that

some months before they had found a large bone there about eighteen inches long which had been taken by some professor of the University.

Mr. Bouvé thought this object was a natural production, in which opinion other members who examined it concurred.

On Reversions among the Ammonites. By Prof. A. Hyatt.

In some remarks relating to the origin of characteristics among animals, Mr. Hyatt stated that he had recently discovered a series of reversionary characteristics among the Ammonites which might be considered worthy of exceptional consideration.

These are the peculiar extensions of the pilæ (ribs so called) and of the intervening sulci, or lateral depressions, across the abdomen or external periphery of the shell, characteristics found especially in *Microceras planicosta* and *laticosta*. The genus which was founded upon this peculiarity and the ("Discoceratidæ)" Arietidæ, having been recently subjected to a revision, certain similarities of a very remarkable kind were observed.

It was found, that among the Arietidæ, *Coroniceras rotiforme*, occurring in the "Bucklandibett" of Oppel, *Cor. nodosum*, in the upper part of the same bed, *Amm. Birchii*, just above this in the "Tuberculatusbett" and *Asteroceras obtusum*, still later in the "Obtususbett," all exhibited to a greater or less degree the planicostan pilæ on the abdomen during some stage of growth in certain individuals.

In *Coroniceras nodosum* this is especially remarkable, and the contrast between the young in those individuals which show this stage, and the adults, with keel channels and septa all so typically arietian in character, is very great. In all these species the planicostan stage appears only in a limited number of individuals in each species, and is always succeeded in course of growth by the features just described of keel, channels and septa, peculiar to the family of the Arietidæ. In *Ophioceras raricostatum*, however, the latest occurring species of the lower Lias which has the typical septa of this family, the planicostan stage is superseded in course of growth only by a keel, this species having no channels.

Of course, in trying to account for the presence of this transient characteristic, one follows the family back to its lowest representatives. These may be said to be two species, *Caloceras torus* and *Arnioceras cuneiforme*, the former closely allied to *Psiloceras psilo-*

*notum* in its septa, and the latter also in its external characteristics. None of the lower forms, however, display, so far as observed, the planicostan stage, though they occur earlier than the species which do exhibit this peculiarity. The planicostan abdomen, therefore, must either be a new characteristic suddenly interpolated in the growth of some individuals, or a reversion to certain ancestral characteristics which have been discontinued for a time in the lower members of the family.

The lower forms of the Arietidæ, *Caloceras torus* and such species as *Amm. nodotianum*, with which this species is closely allied, have septa that are similar to those of certain Triassic species, such as *Amm. Brunneri*[1] and *Amm. Batteni* Strachey, which also resemble *Psiloceras psilonotum* in their septa and forms.

The affinity, therefore, is doubly proved through the latter species, which is a contemporaneous form, and by direct comparison. Besides these there are other species, such as *Amm. lævidorsatus* Hauer, and *Clydonites quadrangulus* Hauer, which show us that the planicostan abdomen is by no means a new feature. Thus, though we cannot assert that the Arietidæ are directly traceable to species in the Trias having the planicostan abdomen, we can say that the family on its lower borders have affinities with Triassic species, and that the planicostan abdomen is found in the Trias. It is probable, therefore, that the same modification, when it occurs in the higher Arietidæ, after a certain interval of time is a reversionary feature.

The young of *Coroniceras nodosum*, *Amm. Sauzeanus* of D'Orbigny, is succeeded in the next bed, the "Tuberculatusbett," by a new form, *Microderoceras Birchii*, whose young are entirely distinct in their mode of development from any of the Arietidæ. They are at first very cylindrical and smooth, then two rows of tubercles are introduced; and sometimes, though rarely, a specimen occurs in which the planicostan abdomen is presented. The septa develop to a more complicated outline in a shorter time than any of the species which follow in the same series or any species among the Arietidæ.

Very similar to this in its adult ornaments and septa is *Microceras biferum*; in fact, I was disposed to think them members of the same genus, until I became aware that a representative species, "*Microd. Hebertii*," existed in the middle Lias. This establishes a distinct series for *Birchii*, and makes it necessary to employ a different name.

[1] Haidinger's Abhand., Bb. 3, p. 23, pl. v, figs. 7-9. Mem. Geol. Survey of India, Stol., vol. v, pl. i, p. 59; pl. v, figs. 2, 3.

The series which we are now considering, has three other closely allied species in the middle Lias.

The first is *Microceras laticosta*,[1] whose young are precisely similar in all respects to *Microceras biferum*, though the adults differ considerably, the planicostan abdomen being brought out more distinctly in the adult stage than in *biferum*. Associated with this species is *Microceras crescens*, whose septa in the young have the same characteristic outline and proportions as in the adult of *Ophioceras raricostatum*, though the whole form and external features identify it with *Microceras laticosta*. Then there is *Microceras arcigerens*, whose septa in the young are like those of the compressed form of *raricostatum* at an earlier age, just before the minor lobes and cells attain a decided prominence.[2] The whorls in this species are flattened dorso-abdominally. The dorsum is broader than the abdomen, and this, together with the flattened aspect of the whorls and the early development of the closely set pilæ, gives an umbilicus closely simulating that of *raricostatum*.

The genus Androgynoceras returns to the peculiar pilæ and tubercles of *Microderoceras Birchii* in the adult, though retaining the adult characteristic of *Microceras* until a late stage of its growth. This is especially remarkable in *Androgynoceras hybridum* (D'Orb.), but becomes confined to an earlier stage in *Androgynoceras appressum*.

The next genus of this same genetic series exhibits in *Liparoceras indecisum* the planicostan abdomen not later than the fourth whorl. In *Liparoceras Henleyi* this is apparent at an earlier stage only, and in *Liparoceras Bechei* it is absent altogether.

The same mode of growth is here returned to, which was first observed in *Microderoceras Birchii*; namely, a smooth, round whorl, succeeded immediately by two lines of tubercles or spines, erected upon pilæ which do not cross the abdomen, except as fine, distinct linear ridges. The difference between the two species, in other respects, is very great, sufficient, in fact, to constitute very distinct genera. It will be observed that we have here a closed series, one in which the

[1] In the Bulletin of the Museum of Comparative Zoology, No. 5, this species appears under the names of *Microceras sinuosum* and *Microceras maculatum*, two species which I now regard as the compressed and gibbous forms of *Mic. laticosta*.

[2] This compressed variety is the one figured by Sowerby, and can only be doubtfully referred to the same species as *O. raricostatus*, which is much flatter on the abdomen, and altogether different in form as well as smaller, though precisely similar in the septa.

genetic connection is traceable from species to species, and these species agreeing quite closely, even as regards the two most widely separable forms in the proportions and outline of their septa. The planicostan abdomen is a reversionary feature, occurring transiently and rarely in *Microderoceras Birchii*, but becoming characteristic of the adult in *Microceras biferum*, and the prominent peculiarity of the remaining forms of this genus.

That this is not an artificial arrangement may be seen by consulting the geological succession of the groups. *Microderoceras Birchii* is found in the "Tuberculatusbett" of Oppel. *Microceras biferum* and *Microceras laticosta*[1] in the "Oxynotusbett," the latter, however, lasting into the middle Lias. In this formation it overlaps *Androgynoceras*, which appears in the "Jamesonibett," followed, and perhaps associated, with *Liparoceras Henleyi* and *Liparoceras Bechei*.

*Ophioceras raricostatum*, with its keel and septa, development and form, allying it closely with the Arietidæ, and indicating that its true position is at the head of a series of this family, occupied geologically an earlier position in the "Raricostatusbett" of the lower Lias, than the two species which resemble it in the middle Lias. These are, undoubtedly, part of the *Amm. capricornus* of Oppel, and are therefore found in the "Davöibett" of that formation.

The planicostan abdomen which occurs occasionally in the young of *raricostatum* before the keel appears, leads to the conclusion, if we credit the hypothesis of evolution, that *Microceras crescens* and *Microceras arcigerens* derived their peculiarities from the same source, and are either directly or indirectly the descendants of this or some other common ancestor. I am disposed to credit the latter supposition. The septa examined were those of young specimens, and in the case of the last named it will be noticed that the resemblance is remarkable in the external features of the shell as well as the septa. No one, however, I am confident, without having subjected them to the closest scrutiny would suspect that they could be separated from *Microceras laticosta*, with which they are also associated geologically. Again, this species is genetically connected with *Microceras biferum* on the one side and with *Androgynoceras hybridum* on the other. According to Quenstedt, the former species is hardly separable in some of its varieties from *Ophioceras raricostatum*, but if the septa are examined closely they are found to differ, and the young are different.

[1] *Microceras laticosta* here includes also the *Amm. capricornus* of Oppel and the two species alluded to in the note above, as *M. maculatum* and *M. sinuosum*.

The superior lateral lobes of *Microceras biferum* always, even in the young, seem to possess a median, minor cell which is absent in *O. raricostatum*. The latter species is much the largest, and the adult septa differ widely. No genetic connection is traceable in their development except in very general terms. On the other hand, the affinities of *M. biferum* in all respects point them out as degraded and dwarfed descendants of *Microderoceras Birchii*, which precedes them, also, in time.

There are other forms, however, which render these questions still more puzzling. A series of single spined or armatus-like species begins with *Deroceras planicostatum*, *Dudressieri* and *Deroceras ziphius* in the "Obtususbett," and is continued by *Deroceras confusum* in the "Raricostatusbett." The development of *Deroceras armatum* does not join it directly with any of these species, and since it occurs only in the lower bed of the middle Lias it need not be considered in this connection.

*Deroceras Dudressieri* has the planicostan abdomen in the young, but in the adult possesses the abdomen of *Microderoceras Birchii*, and in fact differs from that species at this stage principally by the absence of the inner line of spines; the septa are very similar in both. *Deroceras ziphius* differs more widely from *Microderoceras Birchii* than *Deroceras Dudressieri*, but in features which it is not important to discuss here. Then we have *Deroceras planicosta*, which never parts with the typical planicostan abdomen, though in the adult it acquires a single row of spines, as in *Deroceras Dudressieri*; and lastly, *Deroceras confusum* (*Amm. Lohbergensis* Emerson), which differs somewhat from *D. planicosta* in the septa, but more in the slighter form of the whorl.

If, now, we examine closely the development of the septa in *Microderoceras Birchii*, we find that it equally resembles the development of the septa in all of the members of the two series just described, which exhibit the planicostan abdomen largely in their growth. The septa of *Microderoceras Birchii* on the first quarter of the third whorl acquires three minor cells, and the superior lateral lobes become divided, first by the rise of minor cells from the sides of the superior lateral cells. During the same stage a very minute crenulation becomes developed from the side of the inferior lateral cell; this, however, does not increase as fast as its opposing cell, which eventually reaches a very large size, equally dividing the superior lateral lobes.

In *Deroceras Dudressieri* this process is repeated at about the same period, but the dividing cell does not reach a similar prominence, nor do the septa in general terms become quite as complicated as those of the adult *Microderoceras Birchii* until a much later period. Thus, while the lobes and cells of the former have become almost as complicated as in the adult, on the last quarter of the fourth whorl, those of *Deroceras Dudressieri* are a full volution later in reaching the same stage, and are never so deeply cut or foliaceous even in the adult as in the adult of *Microderoceras Birchii.*

The first stage in the development of the latter corresponds to one which occurs in a precisely similar manner in *Deroceras planicosta*, but not until that species nearly reaches the completion of its fourth whorl. In *Deroceras confusum* there is no constancy in the development of the minor cells. Two opposing cells may be brought out unequally, as in the young *Birchii*, or symmetrically, or only one, invariably that from the side of the superior lateral cell. In other words, the adults have all the modes of division found in the different stages of growth of *Birchii*, according to the stage at which arrest of development has occurred. In neither *Deroceras planicosta* or *Deroceras confusum* do the septa reach a stage of complication comparable with any but the youthful stages of *Deroceras Dudressieri* and *Deroceras Birchii.* *D. ziphius* was not examined, but the septa probably accord with the growth of the external ornaments and pilæ which place it near *D. Dudressieri.* The condition of *D. Dudressieri* and *D. ziphius* in the adult stage corresponds in their single external line of spines and rounded abdomen to the early stage of *M. Birchii*, before the internal line of spines is brought out; that of the adults of *Deroceras planicosta* and *D. confusum* to the young of these two species when the spines are developed, and the abdomens still have the planicostan folds. This characteristic, it will be remembered, occurs also in some specimens of *Microderoceras Birchii*, but is only faintly expressed; in *Deroceras Dudressieri* and *Deroceras ziphius* it is constantly expressed in the young, to a later period in the former than in the latter, and is of constant adult value in *Deroceras planicosta* and *Deroceras confusum.* The inference seems to be unavoidable that the species of this series, which occur later in time and are all smaller than *Microderoceras Birchii*, are really dwarfed and degraded descendants of this comprehensive species.

Considering the septa in the next series, we have first *Microceras biferum.* The superior lateral lobes in this species constantly

divided equally, as in the adult of *Microderoceras Birchii*; the superior lateral cells are divided into two unequal portions by a large minor cell, and are very similar in outline to the young of *Deroceras Dudressieri* on the fifth whorl, and to the young of *Microderoceras Birchii* at an earlier period, while the cells are broader and less deeply cut than they were observed to be upon the latter part of the fourth whorl. The young of *M. laticosta* are precisely similar to the young and adult of *Microceras biferum*, but the septa bring out equally the opposing median cells, and the superior lateral lobes thus become unequally divided. In the adults they reach a state of complication comparable to those of *Microderoceras Birchii* and *Deroceras Dudressieri*. With *Microceras laticosta* are associated the strongly reversionary species, which only need a keel to be classified with the Arietidæ. This is especially the case with *Microceras arcigerens*, whose septa, in one specimen, are remarkably similar in proportions and outline to those of *Asteroceras obtusum*, and what is still more remarkable in this same specimen, a slightly raised siphonal line is plainly apparent between the prominent planicostan folds.[1]

In *Androgynoceras hybridum* an equally complicated state of the septa is reached at an early stage, and still earlier in the succeeding species of *Liparoceras*.

*Microceras biferum* is of small size, about an inch in diameter, and at the latest stage assumes a double row of spines, or is smoother; the pilæ in all cases closely simulating those of the adult *Microderoceras Birchii* at this period. Thus it may be said to play the same part that *Deroceras Dudressieri* does in the armatoid or single spined series in its external characteristics and form, while in its septa it corresponds to *Deroceras planicosta*. In the same way *Deroceras laticosta* may or may not have the double row of spines, but never has a single row,[2] and never in the adult returns to the rounded abdomen and peculiar pilæ and ornaments of *Microderoceras Birchii*. *Androgynoceras*, however, does return to this condition in the adult, but at the same time another tendency is developed both in

[1] A close comparison with *Zieten Amm. Turneri*, which I regard as a variety of *Asteroceras obtusum*, shows, however, that a discrepancy exists in the proportions of the abdominal lobe and in the remaining general characteristics of form, which do not permit any attempt to trace a direct genetic connection.

[2] *Microceras biferum* occasionally has a broad projection on the pilæ which might be mistaken for a single spine, whereas it is really formed by the coalescing or arrested development of two rows.

the form and septa. One is a greater degree of involution, the outer whorls as they grow, beginning to spread laterally over the sides of the inner whorls, and the septa keeping pace with the increased breadth of the sides, adding to the number of the auxiliary or inner lobes and cells. This higher degree of complication is carried to its greatest development in *Liparoceras*; which, however, in its highest species, *Liparoceras Bechei*, returns wholly to the mode of growth originally observed in *Microderoceras Birchii.* It proceeds directly from the young, smooth, round-abdomened stage, to produce the double row of tubercles, without the interpolation of the planicostan characteristics. It may be possible that the planicostan stage occurs in some individuals, but this would only complete the parallel with *Birchii* which sometimes faintly expresses this reversionary feature.

The conclusion with reference to this series appears to be, that its members are also at first degraded descendants of *Birchii*, but instead of steadily decreasing in size and ceasing to exist, they first decrease and then speedily increase in size again, adding new elements of complication to the mode of involution, and increasing the number of the lobes and cells. All my attempts to trace a direct connection with those members of the Psiloceratidæ and Arietidæ, which approximate to these series, have signally failed. The planicostan abdomen and the similar septa and forms which are found in the adults of *Psiloceras*, *Caloceras*,[1] and *Ophioceras*, and in *Microceras* and *Deroceras* can be viewed merely as reversions, indicating, as in the different breeds of pigeons, only a common ancestry.

It should be observed also, that where reversion is apparently piled upon reversion, as for instance, in the return of the Birchean characteristics in *Androgynoceras*, after an interval caused by the prepotent development of the planicostan abdomen, and an interval of time also, that this is not a reversion at all. It is, in fact, the resumption of a normal tendency beneficial to the race, which for a time has been entirely suppressed by the prepotent influence of a true reversionary feature.

This can be doubly proved. In the Deroceran series, where no tendency to increased complication or size is observable, the race becomes enfeebled and dies out almost immediately. In the Microceran series, where a constant effort is observable to retain the double

[1] A new genus, of which *Caloceras torus* and *tortilis* are types.

row of spines, to complicate the septa and increase the size, the law of acceleration is brought into full play, and overcoming the tendency of the species to be arrested in development both of size and characteristics, counteracts this tendency and reproduces the usual or natural succession of forms and characteristics.

This may be substantiated in any series of Ammonites. By comparing the lower forms with the higher of the same series it will be found that in most instances, when the series is complete, the species, as in *Androgynoceras* and *Liparoceras*, increase the extent of the involution and the number of lobes. This is precisely what occurs in the Arietidæ, which are even more successful in suppressing the reversionary planicostan tendencies than the Microceran series.

In this family the higher forms, *Asteroceras stellare*, *Asteroceras acceleratum*[1] and others, are much more involuted than any of the lower forms, and this is still more strongly expressed in their descendants, the Amaltheoidæ and Hildoceratidæ of the middle and upper Lias.

It may be objected that *Microceras biferum* is a young form of which we do not yet know the adult. Its size, the limited number of the whorls and the likeness of the septa, in the full grown specimen, to the young of *Deroceras Dudressieri* and *Microderoceras Birchii* might be considered as proof of this supposition. The development is just intermediate between that of *laticosta* and *Birchii*; any larger forms could therefore only intensify this relation.

Besides the negative evidence, however, that no large specimens have ever been found, there is something positive.

The possession of prominent tubercles makes it probable that quite an advanced stage of life is reached, since at a corresponding age in *laticosta* no spines are yet developed.

Similar doubts with regard to the size of *planicosta* and *confusum* in the Deroceran series are answered with more difficulty. The gradual decrease in size which the series makes from *Microderoceras Birchii* through *D. Dudressieri*, *D. ziphius* and *D. planicosta* to *D. confusum*, in all the dimensions of its whorls, when the full sized shells are considered, and the fact that these species, especially *D. planicosta*, have been very extensively collected, appear to make it probable that we now know the shells as they occurred in the localities and strata in which they are found. That they may be dwarfed speci-

[1] New species, which has the abdomen like *Aster obtusus*, but is more involute than any other species of Arietes.

mens which did not develop beyond periods corresponding to the younger stages of lower species appears to be very probable.

Quite a strong confirmation of this tendency of *Birchii* to have dwarfish descendants is to be found in its own series, if we may so call the only species which succeeds it and inherits all of its peculiar characteristics. *Microderoceras Hebertii* Opp.[1] of the middle Lias is precisely similar to *M. Birchii* in all its characteristics, except the smaller size of the spines and the shorter diameter of the full grown shell. The superior lateral lobes are not invariably equally divided by a median minor cell, as in D'Orbigny's figure of this species, but sometimes are unequally divided, this cell being thrown to one side as in *Hebertii*. We know that *Microceras Hebertii* is very much smaller than *Microderoceras Birchii*, because the shell enters upon the old age or senile period of growth before the latter has attained its fullest adult condition.[2] The whorls themselves do not differ in size, so that the shell compares with *Birchii* in the same manner that *biferum* or *Deroceras Dudressieri* compares with it, and in the same manner that *planicosta* and *D. confusum* or *laticosta* compare with these two; they are as large as the young of the species which they resemble in many cases in their whorls, the only difference being that they do not have as many whorls, or attempt to develop the septa beyond a certain youthful or immature condition. They may be said to be arrested in development so far as size is concerned, and retrogressive in development when the reversionary characteristics are considered.

Darwin's close and exhaustive work upon the reversionary characteristics of domesticated breeds is, to a certain extent, unsatisfactory, since, while it points to a probable ancestor, it cannot, from the nature of existing animals, show the preëxisting steps by which the change has been accomplished. The element of time, also, is comparatively short, and the whole evidence is necessarily hypothetical.

In the cases given above, however, it will be noticed that while the facts are not so numerous and conclusive as in the great pigeon argument, they possess the additional confirmation derived from the consideration of the manner of their introduction and their serial succession in geological time.

[1] This is the *Amm. brevispina* D'Orbigny (not Sowerby).

[2] It should have been mentioned that *D. Dudressièri* begins its old age period on the eighth whorl, while still very much smaller than the adult *M. Birchii*.

It will be noticed that these reversionary species[1] all descend from one, to which they may be traced by all the evidences within the scope of observation, and that this single ancestor has occasionally in its own development, characteristics which do not occur in its own series in any of the faunæ of the lower Lias below its own level, and between it and the Trias.

The objection will naturally suggest itself, that perhaps *Microderoceras Birchii* is a migratory species from India, or somewhere out of Eastern Europe, and that in its native haunts we shall probably find the missing links which connect it with the Trias, and farther find that these have the same reversionary features in their growths. But it must be remembered that the planicostan abdomen occurs in some individuals only, a fact very strongly in favor of the supposition that it is a reversion. Darwin's observations seem to establish the fact, that reversions are transient characteristics, and peculiarities directly inherited are, on the other hand, more or less constant, appearing in every individual of the species. Farther, the Arietes are a group native to Eastern Europe, during the Lias, and they most unquestionably revert just as the young of *Microderoceras Birchii*, and in precisely the same transient manner, to the planicostan abdomen,—or rather, as it ought to be called, the Triassic abdomen, in allusion to the age from which it is derived.

## LIPAROCERATIDÆ.

### MICRODEROCERAS.

**Microderoceras Birchii.**

*Amm. Birchii* Sow., Min. Conch., vol. III, p. 121, pl. 267.

This well known species has septa which are different from those of the so-called *Amm. brevispina* of D'Orbigny. A perfect specimen of the French *brevispina* possessed by the Museum is a much smaller shell than the *M. Birchii*, having fewer whorls and entering upon the old age period, whilst the typical *Birchii* is still in its prime. In the young the tubercles and pilæ of *brevispina* are just as prominent during the younger stages of growth as in *Birchii*, but in the adult the spines and pilæ are less prominent, though the latter are more closely set upon the sides of the whorls. The septa, according to

[1] And I might add other species, which are not necessary to the present argument.

D'Orbigny's figures, differ more from *Birchii* than they do from *Amm. muticus*, a true armatoid species, though I think this difference, perhaps, is less than it appears to be from D'Orbigny's figures. *M. Birchii* has two series of forms, as is usual among the Ammonites, one a thick gibbous form, and the other thinner. *Brevispina* is therefore a different species, a stunted or dwarf descendant of *Birchii.*

The young of *M. Birchii* are round, smooth shells, like *Thysanoceras fimbriatum*, marked by prominent lines of growth which represent transient mouths and finally pilæ. They increase very gradually in size, and acquire a line of genicular tubercles on the fourth whorl, which augment rapidly in size and prominence. On the first quarter of the fifth or last of the fourth whorl an internal line of tubercles appears. These increase very slowly in prominence, until they equal those of the outside line. Occasionally the pilæ become bifurcated, and sometimes they cross the abdomen, producing a very faint resemblance to *planicosta*. This last, however, is very faintly and very seldom expressed, and then at a comparatively late period of the growth, so that *Birchii* cannot be said to closely resemble *D. Dudressieri* in this respect.

The septa on the first quarter of the third whorl acquire three minor cells on superior lateral cells, and the superior lateral lobes become divided by the rise of a minor cell from the side of the superior lateral cell. On the last quarter of the fourth whorl these have already become equally divided by the increase of this cell, and the lobes and cells possess much of the adult complication, though the lobes are no deeper than the abdominal lobe. From this it may be seen that the progress in complication is very rapid. Since on the third whorl even the septa have already become nearly as complicated as those of planicosta at a very much later period, and on the fourth whorl are very similar to those of *D. Dudressieri* on the sixth whorl. And on the early part of the fourth whorl, when the superior laterals become equally divided, they must be very similar to those of the adult *M. biferum*, and in fact cannot do otherwise than closely resemble them. Sometimes the young have broad tubercles with the pilæ split into two or three parts as in *subarmatus*, etc.

**Microderoceras Hebertii.**

*Amm. brevispina* D'Orb., Terr. Jurass., Ceph. p. 272, pl. 79.

" *Hebertii* Opp., der Jura, p. 278.

The *Amm. brevispina* figured by Sowerby, appears to be a different species from this, one that shows more prominently the planicostan pilæ. In fact, Sowerby's figure resembles closer what I have called *Microceras sinuosum* (*laticosta* Sow.) than anything else. These distinctions, and the geological gap which divides the two species, induced Oppel to give it a new name.

MICROCERAS.

## Microceras biferum.

*Turrillites Valdani* D'Orb., Terr. Jurass. Ceph., pl. 42, figs. 1, 3.

*Amm. bifer bispinosus* Quenstedt, der Jura, p. 104, pl. 13, figs. 10, 11 and 13.

*Amm. polymorphus mixtus* Quenstedt, der Jura, p. 128, pl. 15, fig. 12.

*M. biferum* Hyatt, Bull. Mus. Comp. Zool., no. 5, p. 80.

This species has septa very distinct from those of *D. confusum*, and they approximate more closely in their outlines perhaps to those of *Psiloceras psilonotum* than to *Caloceras torus* or *Ophioceras raricostatum*. This is due to the presence of a median cell in the superior lateral lobes in both *psilonotum* and *confusum*, and the outlines of the lobes and cells which are very similar also. The species is of small size and may be readily distinguished from *O. raricostatum*, with which Quenstedt thinks it to be very closely allied. The young are not so cylindrical as the young or adults of *raricostatum*, and above all they are never flattened dorso-abdominally with bulging sides, as in the typical *O. raricostatum*. In fact, the abdomen in the young is considerably more elevated, the whole shell being thicker and larger in the young as well as in the adult, than *Ophioc. raricostatum* at the same age or the representative species, *D. confusum*. Subsequently, in many individuals, a much closer external similarity is brought about, and this is especially remarkable when the planicostan variety of the young *raricostatum* is compared with the adult of *biferum*.

When fully developed, the species may or may not have two rows of spines,as the pilæ may extend into one large, undivided projection which cannot be called a spine, but is only a prominent, truncated pilum, with or without very slight points or spines at either extremity.

Quenstedt remarks that these tuberculated varieties, when unsymmetrical, correspond to D'Orbigny's *Turrillites Valdani*. Another variety presents only smooth pilæ, and these when unsymmetrical are, according to Quenstedt, identical with *Turr. Coynarti* of D'Orbigny.

This unsymmetrical form is less common than in *D. confusum*, at least in the collection I have examined; and I have never found such specimens as are mentioned by Quenstedt, which, though unsymmetrical in the young, become symmetrical in course of growth. Most of the specimens that I have yet seen have this tendency to form a spiral, expressed on or towards the right side,—remembering that the external periphery is the abdomen and not the dorsum as is generally supposed—on the same side, in fact, as the want of symmetry so frequent in the lobes of *Psil. psilonotum.*

Though this species has been placed in the same genus as *M. confusum*, I think it can only be considered as one of a different series of planicostan forms, those with two lines of lateral tubercles.

Variety *mixtum.*

The two specimens of this so called species, if the label from the Museum of Stuttgard is reliable, agree very closely with the figure of *Amm. polymorphus* quoted above, and in their septa with *M. biferum* of the same age, as well as with some of the other figures of *Amm. Polymorphus* given by Quenstedt. It may be a variety of that species. One specimen has the Turrillite deformity so often found in *M. biferum.*

**Microceras laticosta.**

*Microceras laticosta* Sow., Min. Conch., vol. VI, p. 106, pl. 556, fig. 1.
" *brevispina* Sow., " " " " fig. 2.
" *sinuosum* Hyatt, Bull. Mus. Comp. Zoology, no. 5, p. 82.
" *maculatum* Hyatt, *Op. cit.*, p. 82.

The young of this species resembles *Microceras biferum* so closely in all its characteristics, that it does not differ so much from it, as the different varieties of that species do among themselves. The form of the whorl in most individuals begins very soon to exhibit a flatness of the abdomen and sides and a sharp bending forward of the pilæ on the abdomen, which are the only distinctive characteristics. The septa are not precisely similar. The differences, however, increase with age as the septa become more complicated and the pilæ more prominent. Two rows of tubercles are acquired in some specimens during the adult stage. The abdomen is still deeply sinuous as in the typical *M. biferum.*

There are two forms of this species, one flatter and less robust than the other, which I have called *M. maculatum.* This has no spines, at least none are apparent upon the casts.

In variety *sinuosum*, the age at which the tubercles are assumed

varies exceedingly, as well as the size and prominence of these and the pilæ upon which they stand.

There seems to be one constant difference between this species and *M. biferum*. The superior lateral lobes are unequally divided into three minor lobes instead of, as in *M. biferum*, being equally divided into two. The young septa are precisely similar in development, and also similar to those of the adult and young of *Deroceras planicosta*; the superior lateral lobes being at first equally divided by a cell arising from the side of the superior lateral cell. This is subsequently met by a cell advancing from the other side and making the usual threefold division of the lobe.

**Microceras crescens.**

*M. crescens* Hyatt, Bull. Mus. Comp. Zoology, no. 5, p. 82.

In this species we have a form which is intermediate between *M. laticosta* and *Ophioceras raricostatum*. It agrees with the latter in its septa, and with *M. laticosta* in its pilæ and general external characteristics of form and growth. In one specimen from Rautenberg, there is a Turrillite distortion, but the deviation of form is in this case very marked toward the left instead of the usual dextral twisting. The superior lateral cells are broad and very slightly indented by the minor, divided into two unequal portions, however, by one minor lobe slightly larger than the rest. The superior lateral lobes are equally divided, the inferior laterals very shallow. All the cells are very broad in comparison to the lobes. The superior lateral lobes are about two-thirds as long as the abdominal lobe, and the inferior not more than half as long as the superior lateral.

**Microceras arcigerens.**

*Amm. arcigerens* Phill., Geol. York, p. 163, pl. 13, fig. 9.

*M. arcigerens* Hyatt, Bull. Mus. Comp. Zool., no. 5, p. 82.

In this species the septa are very peculiar. The outlines are remarkably simple. All the lobes are remarkably broad, the superior laterals and abdominal nearly of the same height, and the inferior laterals fully two-thirds as long as the superior laterals. The whorl is compressed abdomino-dorsally, and much broader on the dorsal than abdominal side. This, and the prominence of the closely set pilæ in the young, gives the shell a very decided resemblance to *O. raricostatum*. It will be observed that in this case the resemblances to *O. raricostatum* are in those very external characteristics in which none could be traced in *M. crescens*.

## DEROCERAS.

**Deroceras Dudressieri.**

*Amm. Dudressieri* D'Orb., Terr. Jurass., Ceph., p. 325, pl. 103.

From France, this species comes to us with the name of *Amm. brevispina*, and from England, as *Amm. armatus* or *Birchii*. With none of these except *Amm. armatus* has it any close affinities. From *Amm. armatus* it differs in the septa, besides having very different young. The shell is strongly pilated and tuberculated and has the planicostan abdomen very distinctly marked, whereas *Deroceras armatus* does not repeat this last feature so decidedly, being much more cylindrical and smoother. The pilæ are also closer together in *Deroceras Dudressieri*, the spines and pilæ also being filled with solid, shelly matter, instead of the spines alone, as in *D. armatus*. Oppel has stated that he found *Amm. Dudressieri* of D'Orbigny in the English lower Lias, and this species is so closely similar in all respects to D'Orbigny's figure of this species, that it seems to be the only one he could have seen. *D. confusum* comes so near to the young of this species that in external characteristics they seem to be nearly identical.[1]

The young is smooth for the first four whorls; the pilæ begin on the fifth, but the tubercles are hardly visible until the last half of the sixth. Soon after the pilæ begin to appear, first as folds on the sides, they stretch across the abdomen and form the planicostan flexures. Though there are some slight differences between the young of this species, on the fifth and earlier half of the sixth whorl, and the typical *planicosta*, both in the shell and septa, they are hardly sufficient to distinguish the two forms separated from the adult whorls. On the seventh whorl the spines are very large but decrease in prominence on the eighth, the pilæ approximating more. The abdomen also becomes more elevated and rotund instead of rather flattish, and the whole form approaches closely to what it is in *Birchii*. The first three whorls have sides widely divergent ; these become rounded on the fourth, flattened on the fifth and sixth, divergent on the seventh, and rounded on the eighth. On the latter part of the tenth whorl the tubercles entirely disappear, the pilæ being reduced to mere folds. The period at which these characteristics may be obtained or

[1] From this I of course exclude the form figured by Quenstedt as having a keel in the young.

parted with, is subject to considerable variation, sometimes an entire whorl earlier or later.

**Deroceras ziphius.**

*Amm. ziphius* Ziet. Verst. Wurt., p. 6, pl. 5, fig. 2.

*D. ziphius* Hyatt, Bull. Mus. Comp. Zool., no. 5, p. 81.

This species occupies a position precisely intermediate between *D. confusum*, *D. Dudressieri* and the true armatoid, large, single-spined species like the typical *armatus*. It has, in the young, an abdomen similar to the planicostan abdomen observed in the two first named species, and in the adult it drops this characteristic for an abdomen similar to that found in *D. Dudressieri*, assuming at the same time a row of large single tubercles. My observations were made upon a single specimen, but they are confirmed by Quenstedt who takes a similar view of the relations of this species from more extended experience.

**Deroceras planicosta** Hyatt.

*Amm. planicosta* Sow., Min. Conch., vol. I, p. 167, pl. 73.

*Microceras planicosta* Hyatt, Bull. Mus. Comp. Zoology, no. 5, p. 80.

For the first four whorls this species is smooth, and the whorl is remarkably broad, with gibbous sides. On the fifth whorl the pilæ are introduced as depressed folds, and gradually increase in size. Spines are never developed in the majority of the specimens, but in a few cases they may be noticed rising either on the cast or the shell, during the third quarter of the sixth volution and becoming quite prominent on the last quarter. The number of pilæ on a single whorl, the time at which they cross the abdomen, and the presence or absence of tubercles, vary remarkably. The abdomens of some specimens may be crenulated by the first pilæ, or they may remain smooth even throughout the fifth whorl, and the number of pilæ vary from twenty in some to twenty-six in others.

The septa also in the young, instead of retaining the usual proportions of the superior lateral cells and lobes, almost obliterate these two which are represented, as in the adult of *Coroniceras tenue*, by a row of minor lobes and cells. It, however, still retains the peculiar median cells of the superior lateral lobes, which are so characteristic of the three series of planicostan forms. These begin to show themselves as lateral expansions or crenulations of the superior lateral cells on the latter part of the fourth or early part of the fifth whorls. The subsequent division of the superior lateral cell into two unequal por-

tions by a pointed minor lobe, the depth of the superior lateral lobes about equal to the abdominal lobe, and the shallowness of the inferior lateral lobes, together with the great breadth of the cells and simplicity of outline of the cells, and absence of numerous minor lobes and cells, are all characteristics of the Arietidæ.

They show that *planicosta*, and the series to which it belongs, come nearest to this family; in fact, are precisely intermediate between the Microceran series and the Arietidæ. If, indeed, specimens of *D. confusum* sometimes have a keel as stated by Quenstedt, the evidence is still stronger. In the adult the triplicate division of the base of the superior lateral cells, and the outlines of the septa, remind us forcibly of *Caloceras torus*, the lowest of the Arietidæ, though the shallowness of the inferior lateral lobes still remains. This, however, is probably sometimes found in *C. torus* and in those specimens in which the development of the pilæ is retarded, an external similarity to the smooth abdomen and fold-like lateral pilæ of *C. torus* is also produced.

**Deroceras confusum.**

*Amm. confusus* Quenstedt, der Jura, p. 127, pl. 75, fig. 89.

" *planicosta* Sow., (pars) Min. Conch., vol. IV, p. 149, pl. 406, not 73.

*Microceras confusum* Hyatt, Bull. Mus. Comp. Zoology, no. 5, p. 80.

*Amm. Lohbergensis* Emerson, Die Liasmulde von Markoldendorf, p. 61, pl. 3, fig. 3.

In this species the first three and a half whorls are smooth and flattened ventrally, the sides bulging as in *O. raricostatum*. This resemblance is still further increased by the development of the pilæ. On the latter part of the fourth, fifth and sixth whorls the resemblance to *raricostatum* is very close, or rather to the earlier stages of that species before the keel appears. On the sixth whorl the tubercles begin to appear and the form changes to a more laterally compressed and thinner whorl, and the tuberculated pilæ cross the abdomen as in the typical *planicosta*.

The septa on the fifth whorl are quite like those of *raricostatum* in their outlines, though the inferior auxiliary lobes and cells slope inwardly and posteriorly. All the shells examined were small, hardly more than an inch in diameter. The developmental resemblance to *O. raricostatum* does not extend to the septa. These have a close similarity to those of *Caloceras torus*, differing however in one

essential point,—the presence of median minor cells which equally divide the superior lateral lobes. This characteristic, though it may be absent in many specimens, is so constant that it prevents the direct connection of the young of this species with the young of *C. torus* or *O. raricostatum*, which it otherwise so closely imitates.

The resemblance to the young of *Microderoceras Birchii* is not so close, however, in external features, though the septa are very closely allied. The Turrillite variety is quite common in this species, whereas it is not so common in the true *Amm. planicosta* Sow.

One of Quenstedt's figures of this species represents a young shell decidedly keeled. This, I think, cannot be of the same species, and his accompanying descriptions do not justify its associations with his *Amm. Bronnii.*

The variations in the lobes are excessive. The median cells of the superior lateral lobes are usually largely developed, often, though not invariably, retaining the youthful or one-sided aspect which they have in the young of *Deroceras planicosta* and *M. Birchii.* In some specimens, however, they are very small, and the lobes are unequally divided by two very minute minor cells. These lobes, in other words, may be equally divided, or have all the gradations from this to a state of unequal division. The same lobes are either longer, equal to, or shorter than the abdominal lobe, but seem invariably to greatly exceed the inferior lateral lobes.

**Deroceras densinodum.**

*Amm. armatus densinodus* Quenstedt, der Jura, p. 105, pl. 13, figs. 9, 10.

*D. densinodum* Hyatt, Bull. Mus. Comp. Zool., no. 5, p. 84.

This species does not apparently occur in the middle Lias as stated in my paper in the Bulletin of the Museum of Comparative Zoology, but only in the lower Lias. The mistake resulted from an erroneous reading of the label on the specimen. It may be only a variety of *D. confusum*, but the young differ somewhat, the abdomen is narrower and the septa are invisible in the single specimen of *D. densinodum* in the possession of the Museum.

According to Quenstedt's figure this species is really an *armatus* in which the young is pilated or ribbed at a very early period, instead of being smooth as in *armatus* proper. Having only the young it is impossible to say much about the affinities of the shell; it is, however, evidently a member of the planicostan group or series of *Deroceras.*

ANDROGYNOCERAS.

From the specific descriptions it will be seen that we have here two groups or series, both developing from the first variety of one species, *Androgynoceras hybridum*. From this we have the series in which acceleration of development produces the flattened abdomens and broad whorls of the second variety of *A. hybridum*, and of *Liparoceras indecisum*, the more elevated, though still broad whorled adult of *L. Henleyi*, with young just like the adults of *A. hybridum*, second variety, and finally the high whorled *L. Bechei*. The amount of involution is just proportionate to this progress, reaching to the first line of tubercles in the first three forms, to the second only in the adults of the fourth, and to the second in both the young and adults of the fifth.

The second offshoot or series contains only one species, *A. appressum*, which is highly accelerated when compared with *A. hybridum*. This has remarkably flattened sides and the connection with the other is shown by the development of the young. Whether this ought to be set aside as a distinct genus, or not, will depend upon the discovery of other descendants.

**Androgynoceras hybridum.**

*Amm. hybrida* D'Orb., Terr. Jurass. Ceph., p. 285, pl. 85.

*And. hybridum* Hyatt, Bull. Mus. Comp. Zool., no. 5, p. 83.

For six volutions the shell is apparently inseparable from certain forms of *M. laticosta*. Upon the seventh whorl, instead of continuing the same degree of increase in size, a more rapid enlargement takes place, the lateral pilæ become less prominent and more crowded, sometimes coalescing near the umbilicus. The inner tubercles in the latter case, also, either partially or entirely coalesce. The abdomen in the meantime has become more prominent, less furrowed, and more rounded, and the sides converge outwardly. The abdominal pilæ split up each into several minor ridges on the latter part of the seventh whorl, reducing these furrows to a minimum.

A variety of this species from Schippenstadt and Semur completes the same stages of growth as have been described in *A. hybridum*, a full volution earlier. It has at the end of the sixth volution a whorl nearly as large and of the same form, but much broader in proportion to the length than in the first. The pilæ begin to take upon themselves similar characteristics. I am unable to state whether this or some intermediate form between this and the first variety is the

one described by D'Orbigny; or with any certainty, whether the first variety is a distinct species, though it seems to be such.

**Androgynoceras appressum.**

*And. appressum* Hyatt, Bull. Mus. Comp. Zool., no. 5, p. 83.

For perhaps the first four or five volutions the shell is similar to the young of thinner varieties of *M. laticosta*. The extent of envelopment, also, is slight; soon however, on the last of the fifth or first of the sixth the planicostan pilæ split into several ridges united at either end by tubercles. The abdomen at this period, the inclinations of the sides, etc., closely resemble the characteristics of the adult of the first variety of *A. hybridum*.

## LIPAROCERAS.

**Liparoceras indecisum.**

*Lip. indecisum* Hyatt, Bull. Mus. Comp. Zool., no. 5, p. 8.

This is evidently a very much more accelerated form than even the second variety of *A. hybridum*. It still preserves, however, the form of the adult of this species. The young, if I am correct in referring a young specimen from Rautenberg to this species, has planicostan pilæ certainly until after the completion of the fourth, and probably until near the end of the fifth volution.

**Liparoceras Henleyi.**

*Amm. Henleyi* Sow., Min. Conch., vol. II, p. 161, pl. 172.

*Naut. striatus* Rein, Naut. et argo., p. 85, pl. 8, figs. 65, 66.

*L. Henleyi* Hyatt, Bull. Mus. Comp. Zool., no. 5. p. 84.

This species differs from the last in not repeating the planicostan abdomen at all, unless upon a volution preceding the last quarter of the third. This seems improbable, though it may occur in some specimens. At this period in the specimens examined all the adult characteristics were well developed, and it only remained for them to increase in size. The form of the shell is also precisely that of the adult *A. hybridum*, second variety, or at least of that shell at the end of the sixth volution.

The *L. Henleyi* differs from *L. Bechei* in having larger and more prominent tubercles, a broader whorl in proportion to the height, and in the slighter involution of the young. For the first four whorls the involution does not reach the internal line of tubercles, leaving a larger umbilicus than in *L. Bechei*. In one specimen from Lyme Regis the only distinction from *Bechei* consists in this single

characteristic. Usually, however, the angular, prominent, ribbed tubercles of the younger whorls at once show great differences. While *L. Henleyi* thus seems to show variations advancing towards *L. Bechei*, the last never has a variety like *L. Henleyi*.

**Liparoceras Bechei.**

*Amm. Bechei* Sow., Min. Conch., v. III, p. 143, pl. 280.

" " Ziet. Verst. Wurt., p. 37, pl. 28, fig. 4.

*Lip. Bechei* Hyatt, Bull. Mus. Comp. Zool., no. 5, pl. 84.

Fold-like lines of growth are prominent in the young, which are otherwise smooth and rounded. These increase in number and sharpness until they become true pilæ.

Two lines of tubercles are introduced, also, in the young, but appear either quite late or comparatively early on the third whorl.

The septa on this volution precisely resemble the septa of the nearly adult *M. laticosta*. They have very broad abdominal and superior lateral lobes; the latter unequally divided. The siphonal cells are very large. In one specimen a very decided resemblance to *A. sternalis* is produced by the angulation of the abdomen and the unusual development, for so young specimens, of the lateral pilæ with their tubercles on the last quarter of the third whorl.

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## Section of Microscopy. October 12, 1870.

Mr. E. Bicknell in the chair. Fifteen members present.

Mr. C. Stodder exhibited a slide containing albumen coagulated with carbolic acid, which had been carefully sealed in July, 1869. With a high power, he showed that the particles were in continual vibration. He thought the appearance of this preparation was identical with what was represented in figures published by Dr. Lionel S. Beale, in his germ-theory of disease.

Dr. C. Ellis remarked, that all such particles from their minuteness, appeared alike; and that any solid in a state of fine subdivision exhibited this molecular motion. Their motion was no proof that they were alive.

The following paper was presented:—

## A Method of Producing very Low Powers for the Microscope. By Edwin Bicknell.

I use a plano-convex "collecting," or "reducing" lens, in the draw tube of the microscope, about midway between the objective and eyepiece; it is achromatic, of four inches focal length and six-tenths of an inch in diameter.

Placed about midway between the objective and eyepiece, its effect is to reduce the magnifying power of any objective about one-half; at the same time shortening the "working distance" of the objective materially. Used with a 2-inch, 3-inch, or 4-inch objective it practically makes them 4-inch, 6-inch, or 8-inch, respectively. Its effect is not good with high powers, where of course it is not needed.

By using a similar lens as an objective, in connection with the reducing lens, I have a very low power of only five or six diameters and three and a half inches working distance. This power takes into the field of the lowest eyepiece an object, eighty-eight hundredths of an inch in diameter, with a depth of focus of nearly half an inch.

This lowest power I have found very useful in viewing whole flowers, large sections, Zoophytes in glass troughs, etc., as all their parts, both breadth and depth, were brought into view at once. I do not bring this forward as an "optically" perfect instrument, but as a convenient method of producing very low powers for certain purposes. Below I give a table of diameters with the different eyepieces.

| | *Lowest power.* | *3-inch objective.* |
|---|---|---|
| Eyepiece A. . . . | 5 diameters. | 10 diameters. |
| " B. . . . | 10 " | 18 " |
| " C. . . . | 18 " | 32 " |

It will be seen that the lowest power gives only the magnifying power of the eyepieces used, and the 3-inch only about double the power.

## Wednesday, October 19, 1870.

The President in the chair. Forty-two persons present.

The following papers were presented:—

### On the Geology of the Vicinity of Boston. By Dr. T. Sterry Hunt.

During the past week I have made several geological excursions in the neighborhood of Boston, in some of which I was accompanied by Prof. N. S. Shaler, and in the others by Prof. Alpheus Hyatt; the familiarity of these gentlemen with the local geology has greatly facilitated my examinations. The rocks which we have seen may be considered in three classes. A, the crystalline stratified rocks; B, the eruptive granites; C, the unaltered slates, sandstones and conglomerates. The former of these may be separated lithologically into two divisions; the first being the quartzo-feldspathic rocks. Among these are included the felsite-porphyrites of Lynn, Saugus and Marblehead, with their associated non-porphyritic and jasper-like varieties, the compact feldspar of Hitchcock, who has well described these rocks in the Geology of Massachusetts, pages 664, 667. Associated with them is a granular quartzo-feldspathic rock which is often itself porphyritic, with feldspar crystals, and sometimes appears as a fine grained syenitic or gneissoid rock, often distinctly stratified. This has been described by Hitchcock as intermediate between porphyry and syenite; his syenites with "a nearly or quite compact feldspar base" and some of his porphyritic syenites (Geol. Mass., pp. 668, 669) will probably be found to belong to these granular eurites, which I connect with the porphyries. These rocks are seen intimately associated with the porphyry on Marblehead Neck, also in Marblehead, and underlying the argillites of Braintree and Weymouth.

The second division of the rocks of class A includes a series of dioritic and chloritic rocks, generally greenish in color, sometimes schistose, and frequently amygdaloidal. They often contain epidote, quartz, and calcite, and occasionally actinolite, amianthus, scaly chlorite, and copper pyrites. This series holds a bed of dolomite at Stoneham, and serpentine in Lynnfield, where bedded serpentines, dipping at a high angle to the N. W., occur apparently in the strike of these dioritic and epidotic rocks, which include the greenstones of

Dr. Hitchcock, described by him as occasionally schistose and passing into hornblende slate, (Geol. Mass., pp. 548, 647); and also his varioloid wacke, under which name he describes the green and chocolate-colored amygdaloidal epidotic and chloritic rocks of Brighton, and the somewhat similar rocks of Saugus, which are seen within a few hundred feet to the northwest of the limit of the red jaspery petrosilex. This series of magnesian rocks is apparently identical with that which occurs with dolomite and massive dark colored serpentines in the city of Newport, R. I., where the beds have also a high dip to the northwest. A similar series of strata is largely displayed on the islands and along the shores of Passamaquoddy Bay. The dioritic and chloritic beds towards their base are there interstratified with red felsite-porphyries like those of this vicinity, which, associated with granular eurites, form great masses in that region. I regard these two types of rocks as forming parts of one ancient crystalline series, which is largely developed in the vicinity of Boston, and may be traced at intervals from Newport to the Bay of Fundy, and beyond. To this same series I refer the great range of gneissic and dioritic rocks with serpentines, chloritic, talcose and epidotic schists which stretches through western New England.

These ancient rocks are in various places penetrated by intrusive granites, which are generally more or less hornblendic—the syenites of Hitchcock and others. They often contain true feldspars, as in the well-marked granite of Newport, which there cuts the greenish dioritic and sometimes amygdaloidal rocks. In this vicinity, besides the granites of Cape Ann and of Quincy, which probably belong to this class, examples of intrusive granites (or syenites) are well seen in Stoneham and in Marblehead, where they cut the greenish chloritic rocks, and on Marblehead Neck, where they are erupted among the felsite-porphyries. In all of these places the phenomena of disruption and enclosure of fragments of the broken rock in the granite are well seen, the lines of contact being always sharp and well-defined. Considerable varieties in the colors and the constitution of these erupted rocks are observed in different localities, and sometimes even in portions of the same mass. This is well seen on Marblehead Neck, where the aspect is such as might result from the simultaneous gushing forth of two somewhat different varieties of granite, as if from contiguous beds of an older granitic gneiss beneath. In one case at Marblehead the eruptive granite is traversed by segregated or endogenous veins of red orthoclase with quartz and epidote.

The evidences of the eruptive origin of the granites of our vicinity were well described by Hitchcock, though, as before remarked, he includes with them, under the common name of syenite, many rocks belonging to class A. The coarse white granites on Marblehead Neck are seen in one place intersecting thin bedded and somewhat contorted quartzites, which hold dark micaceous layers, and resemble rather a fine grained gneiss.[1] These beds, which occupy but a small area, are not unlike the strata which at Biddeford, Maine, and in some parts of Nova Scotia, are cut by granites, and probably belong to a newer series than the rocks of class A, as above described. All of these rocks, the granites included, are on Marblehead Neck traversed by dykes of intrusive greenstone, which are sometimes very similar in aspect to certain of the bedded diorites of A.

Of the rocks of class C, the unaltered argillites of Braintree, holding a primordial fauna, were observed by Prof. Shaler and myself to rest directly upon a hard porphyritic felsite of the ancient series. The line of demarkation between this and the soft argillite is very distinct. A more detailed examination than we were able to make during a violent rain-storm, will be required to show whether the contact here observed is due to original deposition or to a subsequent dislocation. Reddish granulites directly underlie the black argillites of Weymouth, and the quartzites with conglomerates and argillites of Chestnut Hill Reservoir, and of Brighton near by, are in several places observed in contact with the old dioritic and epidotic rocks already noticed. The Roxbury conglomerate was observed to contain pebbles of the felsite-porphyries, diorites and intrusive granites of the older series, besides, as already remarked by Hitchcock, fragments of argillaceous slate. In this connection may be noticed a remarkable recomposed rock long since correctly described by the same careful observer, as an aggregate of broken-up and recemented felsite-porphyry, (Geol. Mass., pp. 547, 665). He observed it at Hingham and Cohasset, and Mr. Hyatt has since found it on Marblehead Neck, resting directly on the parent rock, and very firmly cemented. The unequal weathering of the surface, however, clearly shows both its conglomerate character and the inferior hardness of the cement. Such conglomerates may of course be of very different ages, a remarkable example of a similar reconstructed felsite-por-

[1] These micaceous and gneissic rocks have since been found by Mr. Hyatt to be largely exposed at Naugus Head in Marblehead, where they run to the west of north and are nearly vertical.

phyry adjoining the old porphyries of Passamaquoddy Bay, is interstratified with fossiliferous sandstones which show it to be of Silurian age. The same thing is observed in Cobscook Bay, near to Eastport, in Maine; while elsewhere similar conglomerates are met with of Lower Carboniferous age.

The fact that the primordial strata of Braintree have suffered no metamorphism is the more significant, since the beds of similar age in New Brunswick and Newfoundland[1] rest uncomformably on crystalline strata supposed to belong to the same ancient series that underlies the Braintree beds, and are, like these, unaltered sand and mud rocks. The alteration in the paleozoic strata along our northeastern coast is apparently confined to the proximity of intrusive rocks. Thus the so-called flinty slates at Nahant, containing patches and bands of epidotic matter, are, as long since pointed out by Hitchcock, penetrated by great masses of eruptive greenstone, and I have found that at distances of a few yards from this they appear as argillites but little indurated. The Upper Silurian beds about Passamaquoddy Bay are, in like manner, altered in the immediate vicinity of eruptive greenstones, becoming hard, greenish and epidotic, but the same beds a few feet distant are unchanged and earthy in their aspect.

The difficulties which have attended the study of the geology of this region have arisen in part from great lithological diversities, which led our early observers to separate into different classes rocks of the same geological series; while on the other hand, rocks geognostically very unlike were brought together. These points are shown in what we have cited from Hitchcock with regard to the syenite and greenstone, under both of which heads he has placed with true eruptive rocks others which are doubtless stratified. The indigenous greenstones or diorites were at the same time separated from the amygdaloids and serpentines (which were correctly looked upon as stratified rocks), a misconception which could only lead to confusion. I have ventured in these remarks to state briefly the conclusions to which a few days of observation have led me with regard to the relations of some of the rocks of this vicinity. They will be found, I think, to show a greater simplicity than has hitherto been supposed in the geological structure of the region, and are pre-

[1] Mr. Billings informs me that he regards the *Paradoxides Bennettii* (Salter) from Newfoundland as identical with the *Paradoxides Harlani* (Greene) from Braintree.

sented, imperfect as they must needs be, in the hope that they may lead some of the members of this Society to give more attention to this very interesting subject of study.

## Preliminary Sketch of a Natural Arrangement of the Order Docoglossa. By W. H. Dall.

The following is a preliminary sketch of a more natural arrangement of the mollusca, contained in the Orders *Cervicobranchiata* and *Cyclobranchiata* of Gray, taken from the results of investigations now in preparation for publication in a more extended form. These investigations having shown that no line can be drawn between the two orders of Gray above mentioned, it follows that they must be consolidated; and for the group in question, the Order *Docoglossa* Troschel (minus the *Polyplacophora* and *Solenoconchæ*), has been restricted and adopted. As the denominations previously applied, all imply an erroneous idea of the structure of the animals, this course has been determined upon in preference to using prior, but incorrect, ordinal names.

The order, as here restricted, was first recognized by me in "A Revision of the Mollusca of Massachusetts" (Proc. Boston Soc. Nat. Hist., XIII, p. 245, March, 1870) at which time only the characters of the suborder *Abranchiata* had been fully worked out. Since that time I have investigated the characters of the suborder *Proteobranchiata*, as here restricted; and in a paper read before the American Association for the advancement of Science, at Troy, September, 1870, of which a synopsis was published in the American Naturalist, (November, 1870, p. 561,) I restricted the order *Docoglossa* within its present limits, from the researches above mentioned. Among the fruits of these investigations was the definite exclusion of the *Gadiniidæ* from the order. (See Am. Journ. Conch., VI, p. 8, 1870). It is proper to state that Prof. Theodore Gill had, upon general considerations, adopted the same limits for the order in his unpublished manuscript, although the conclusions to which I have been led were the result of independent anatomical investigations upon my part, which, so far as I am aware, are the only ones, including the whole order, which have been made. I am indebted to Prof. Gill for suggesting the very appropriate names by which I have designated the suborders as restricted.

# Class GASTEROPODA.

## Order DOCOGLOSSA Dall ex Trosch. 1870.

### Suborder Abranchiata (Gill) Dall. 1870.

Radula furnished with a rhachidian tooth and two uncini. Animal destitute of eyes, branchiæ, and lateral teeth on the area.

### Family Lepetidæ (Gray) Dall. 1869.

Shell patelliform; apex erect, or anteriorly directed. Muzzle of the animal with an entire edge; furnished with a tentacular appendage below on each side.

Formula of the radula, $\frac{1}{2\,(0\cdot0)\,2}$.

#### Genus **Lepeta** Dall ex Gray. 1869.

A. *Lepeta* Dall.

Rhachidian tooth tricuspid, concave in front; central cusp simple, much the largest; lateral cusps small, emarginate, base very broad; uncini with simple cusps.

Type *Lepeta cæca* (Gray) Dall, Am. Journ. Conch., v, p. 141, 1869.

B. *Cryptobranchia* Dall ex Midd. 1869.

Rhachidian tooth with three short cusps, equal and parallel before and behind; not pointed. Base moderately broad, more or less ornate behind; uncini with simple cusps.

Type *Cryptobranchia concentrica* (Midd.) Dall, Am. Journ. Conch., v, p. 143, 1869.

C. *Pilidium* Dall ex Forbes. 1869.

Rhachidian tooth tricuspid, central cusp much the largest, convex in front; lateral cusps simply pointed; base narrow. Uncini with cusps obliquely twisted.

Type *Pilidium fulvum* (Forbes) Dall, Am. Journ. Conch., v, p. 146, 1869.

## Suborder Proteobranchiata Dall. 1870.

Animal provided with three lateral teeth, with eyes and with external branchiæ. Rhachidian tooth usually wanting. Uncini present or absent.

### Family Acmæidæ Carpenter.

Shell patelliform; animal provided with a free cervical branchia, issuing from the left side of the body, above the head; muzzle surrounded with a frill of integument. Radula without a rhachidian tooth and with three lateral teeth on each side; with or without accessory uncini.

A. Destitute of a branchial cordon. *Acmæa.*

1. **Acmæa** Eschscholtz, 1828. Syn., *Tecture* Cuvier, 1830; *Tectura* Gray, 1847.
   Teeth subequal, parallel in both axes; uncini absent; muzzle frill produced into two lappets.
   Formula, $\frac{0}{0(1-1-1\cdot1-1-1)0}$.
   Type *A. mitra* Esch., Zool. Atlas, v, p. 18, no. 1. 1833. Philippi. Zeit. f. mal., p. 106, 1846.
2. **Collisella**[1] Dall, n. subg.
   (a). Third lateral smaller than, and opposed to, the second. First laterals anterior. Muzzle frill without lappets. A single minute uncinus on the pleura.
   Formula, $\frac{0}{1(2-1\cdot1-2)1}$.
   Type *Acmæa pelta* Esch., l. c. no. 5. 1833.
   (b). Provided with two minute uncini on the pleura. (? *Collisellina*).
   Formula, $\frac{0}{2(2-1\cdot1-2)2}$.
   Type *Patella saccharina* Lin., Gmel., S. N., p. 3695, no. 19. 1792.

B. Cordon present; interrupted in front. *Lottia.*

1. **Lottia** (Gray) Cpr., 1863. Without muzzle lappets. Teeth as in *Collisella* (a).
   Formula, $\frac{0}{1(2-1\cdot1-2)1}$.

[1] From *Collis*, a mound, in allusion to their shape.

Type *L. gigantea* (Gray) Cpr., Am. Journ. Conch., II, p. 342. 1866.

C. Cordon present; complete, uninterrupted. *Scurria.*

1. **Scurria** Gray, 1847. No muzzle lappets. Teeth as in the last. Formula, $\frac{0}{1(2-1\cdot1-2)1}$.

Types *S. scurra* (Lesson) Gray, P. L. S., 1847, p. 158. *S. mesoleuca* (Mke.) Cpr., Maz. Cat., p. 208, no. 263 (as *Acmæa*). 1857.

## Family PATELLIDÆ H. & A. Adams.

Animal without a cervical gill or muzzle frill. Rhachidian tooth rarely present; uncini three in number. A more or less complete cordon of branchiæ between the mantle edge and foot.

A. Branchial cordon complete.

*a.* Provided with a rhachidian tooth. *Ancistromesus.*[1]

1. **Ancistromesus** Dall, n. g. Two inner laterals on each side anterior to the third, which is larger and denticulate. Branchial lamellæ produced, arborescent. Sides of foot smooth.

Formula, $\frac{1}{3(1-2\cdot2-1)3}$.

Type *Ancistromesus mexicanus* Dall ex Brod. & Sby. (as *Patella*) Zool. Journ., IV, p. 369. Rve. Conch. Ic., *Patella*, pl. I, no. 1. 1855.

*b.* Without a rhachidian tooth. *Patella.*

1. **Patella** Lin., 1757. Lateral teeth and foot essentially as in the last. Branchial lamellæ linguiform, short, subequal all around.

Formula, $\frac{0}{3(1-2\cdot2-1)3}$.

Type *Patella vulgata* Lin., Syst. Nat., Ed. 12, p. 1258, no. 758. 1767.

[1] From Αγκιστρον, a hook or tooth, and μεσος, median or middle.

**2. Patinella**[1] Dall, n. subg. First inner lateral on each side anterior to the other two. Second laterals largest, denticulate. Foot with a scalloped frill, interrupted only in front. Branchiæ as in *Patella*.

Formula, $\frac{0}{3(2-1\cdot1-2)3}$.

Type *Patinella magellanica* Gmel. (as *Patella*) Syst. Nat. I, p. 3703, no. 52. 1792.

**3. Nacella** Schum., 1817. Shell thin, pellucid, apex anterior. Foot frilled, as in *Patinella*. Teeth bidentate, arranged as in the last. Branchial lamellæ very small in front, but not interrupted.

Formula, $\frac{0}{3(\frac{2}{2}-\frac{1}{2}\cdot\frac{1}{2}-\frac{2}{2})3}$.

Type *Nacella mytilina* Gmel., Syst., Nat., vol. I, p. 3698, no. 28, 1792 (as *Patella*) = *Nacella mytiloides* Schum., 1817, and *Patella cymbularia* Lam., 1819.

B. Branchial cordon interrupted in front. *Helcion*.

**1. Helcion** Montf., 1810. Shell solid, capuloid, with pectinated ribs. Teeth?

Type *Helcion pectinatus* (as *Patella pectinata*) Lin., Gmel., Syst. Nat., p. 3710, no. 93. 1792.

**2. Helcioniscus**[2] Dall, n. subg. prov. Shell depressed, solid, with a subcentral apex. Teeth arranged as in *Patinella*. Sides of foot smooth.

Formula, $\frac{0}{3(2-1\cdot1-2)3}$.

Type *Helcioniscus rota* (Chemn.) Rve. (as *Patella*) Conch. Icon. pl. XVII, fig. 39, a, b, c.

**3. Patina** (Leach) Gray, 1840. Shell very thin, pellucid. Sides of foot smooth. Third pair of laterals posterior, largest, denticulated.

Formula, $\frac{0}{3(1-2\cdot2-1)3}$.

Type *Patina pellucida* Lin., Syst. Nat., XII, 1260, no. 770 (as *Patella*). 1767.

[1] From *patina*, a dish.

[2] Diminutive of *Helcion*.

* * * * * *

Soft parts?

1 **Metoptoma** Phillips, 1836. Shell ovate, triangular, apex subcentral; posterior end truncated, or deeply, broadly emarginated. Type *Metoptoma pileus* Phil. Geol. Yorkshire, II, p. 223, 1836. Fossil in the carboniferous formation of Great Britain. Many of the species referred to this genus by Billings and other palæontologists, clearly do not belong to it.

The above sections, with the exception of *Helcion*, are well defined and will probably include the greater portion of the known species, though some may prove distinct from any yet examined. Extensive study of the soft parts has shown, beyond dispute, that generic distinctions founded on the shells alone, are wholly valueless, as the latter cannot be depended upon for diagnostic characters, and many so-called genera and subgenera founded upon the shells, will fall as synonyms, or retain their places solely as the result of accident. *Scutellina*, as far as known, is equivalent to *Acmæa*. *Olana*, *Scutellastra*, *Cellana*, etc., are founded upon characters of hardly specific value. The results of extended researches on this order are now in press, which will include a thorough revision of the synonymy in full, with a definite reference of many species to their proper position, as determined by the sum of all their characters.

*Voted:* To amend Article VI. of the Constitution as proposed at the meeting of May 18th.

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## Section of Entomology. October 26, 1870.

Mr. Edward Burgess in the chair. Ten members present.

Mr. Philip S. Sprague exhibited specimens of an *Aleochara* which he had discovered to be parasitic on *Anthomyia ceparum*, or an allied species, attacking the cabbage; and of sweet corn attacked by *Sitophilus oryzæ*. He also read a letter from Mr. E. C. Rye, of London, giving the information that

the types of Kirby, described in the Fauna Boreali Americana, as well as in his Monographia Apum Angliæ, are still in existence, in the British Museum.

The following paper was read: —

NOTES ON THE FLIGHT OF N. E. BUTTERFLIES. BY CHARLES S. MINOT.

In the course of the past summer I spent a good deal of time investigating the flight and some of the habits of the imagines of our common New England butterflies. Though my studies on this subject are far from complete, yet a few remarks may not be uninteresting.

My experiments and observations have not as yet extended to the mechanical principles, but merely to the character, of the flight, and the influence of certain structural differences upon it. I find that, according to their flight, the New England butterflies may be divided into three large divisions, each of which may be again divided into two or three sections, which may be further divided into groups, each of which will contain usually a single genus and all the species of that genus. I give an example quoting the three main divisions.

I. Flight sweeping, long, sailing.
  A. Not turning often.
    a. Strong and steady.
      1. Prolonged, swift. Papilio.
II. Flight not sailing, shorter than in I, more or less undulating.
III. Flight jerky, generally short.

The terms which I have used above will be understood only by those who have watched the butterflies out of doors. There is another division, more artificial but equally possible, which has no immediate connection with the flight, which I give below.

Genera, the individuals of which, if disturbed, return after a short interval to the same spot.

I. Usually; as Thecla, Grapta, Hesperia, etc.
II. Seldom; as Melitæa, Pieris, etc.

I will speak only of one or two of the other facts that I have noticed. A large thorax which allows room for powerful muscles, with a stiff crust, which gives a firm point from which the muscles can act,

indicate that the flight of the insect will be powerful and zig-zag. The shape of the wing also exerts great influence; e.g., a shouldered costa adds strength to the wings and therefore to the flight;[1] or again, if the wings are very broad, the insect finds difficulty in moving them, and the flight becomes slow and unsteady. The abdomen is used as a rudder. It is by means of this that dragon-flies can turn so quickly. It may be well to mention here that all insects turn, during flight, in one of two ways: first, as in the case of the butterflies, by making a decided angle, the result being a zig-zag course; second, as in the dragon-flies, by making a curve, the course through the air becoming a series of curves, each of which is tangent to the preceding one. Numerous examples in confirmation of my views might be adduced.

The position of butterflies when at rest, I have studied in some detail, and have arrived at some interesting results. A great variety is found in their postures by day, but they are all different from those which are assumed by night, which are almost exactly the same for every individual of the same species.

Having often been asked where insects spend the night, I selected two of our commonest species, *Colias Philodice* Godt, and *Pieris rapæ* Schrank, and watched them for a great many evenings. A little before sundown they begin to alight in the grass very frequently; as it grows later they become more and more inactive, until finally they will allow themselves to be trodden upon, pinned, and handled in any way. Before the twilight is ended they creep down, or descend in some manner, I know not how, to the very roots of the stalk or blade of grass they have selected for their resting place. They always choose a perpendicular stalk. The wings are raised over the back, with the outer edges pressed together. The antennæ are kept nearly perpendicular to the axis of the body and are almost concealed between the front edges of the fore-wings.

Mr. F. G. Sanborn exhibited specimens of Lepidoptera from California and Neuroptera and Geometridæ, presented by Dr. G. F. Waters; also insects purchased of G. W. Belfrage, of Texas, and a collection made by Prof. A. S. Bickmore, in Southern Asia.

[1] Wallace, Contrib. Nat. Selec., p. 179, also has noticed this fact.

Wednesday, November 2, 1870.

The President in the chair. Thirty-nine persons present.

Prof. N. S. Shaler made a verbal communication on the changes which have taken place on the Atlantic Coast; and especially on the denuding action of ice.

Mr. E. Bicknell referred to the flexible, muscular preparations exhibited by Dr. Dwight, at a previous meeting, and called the attention of the Society to some specimens of human muscle, and that of a turtle, (the glistening character of the latter still preserved) which he had prepared with equal parts of alcohol, glycerine and water. These preparations he had found useful for microscopical examination and dissection.

Second and final action was taken on the proposed amendment of Article VI. of the Constitution, and it was

*Voted:* That Article VI. of the Constitution, be amended by inserting the words "after having been nominated at a preceding meeting"; so that the article shall read, officers shall be chosen by ballot, after having been nominated at a preceding meeting, and a majority of votes shall be sufficient for a choice.

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Section of Microscopy. November 9, 1870.

Mr. E. Bicknell in the chair. Seventeen members present.

Calvin Ellis, M. D., Thomas Dwight, Jr., M. D., Alpheus Hyatt, G. F. Marden, C. S. Minot, and J. A. Swan, were elected members of the Section.

Mr. Bicknell remarked that he had found great numbers of *Isthmia nervosa* on the fronds of a species of *Callithamnion*, off Portland harbor, yet the mud dredged from the same place contained none of their frustules; he could account for their total disappearance only by supposing them to have been absorbed by the water.

Prof. A. Hyatt referred to some points in the embryology of the fossil Nautiloids, discovered by a microscopic examination of the umbilici of some fossil specimens. He showed that the embryos of the same age are quite variable in their mode of development.

Mr. A. Tuttle described a form of *Paramœcium*, from Fresh Pond, Cambridge, differing from the common species in having a much smaller vestibule, occupying only one-fifth of the length and one-eighth of the breadth of the animal.

Mr. Bicknell described the structure of whalebone. He said the lamellæ were composed of a single row of hairs set closely together and united into a plate at the base by a horny sheathing, while their ends were free. These hairs are hollow throughout their entire length, and he thought each one probably contained a nerve-fibre.

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Wednesday, November 16, 1870.

The President in the Chair. Fifty persons present.

Count Pourtales made some remarks on the constitution of the bottom of the ocean off the east coast of the United States, south of Cape Hatteras, as developed by the soundings and dredgings of the U. S. Coast Survey.

The chief constituent is silicious sand from the coast line to about the one hundred fathoms line, a limit which also coincides nearly with the inner edge of the Gulf stream for a great portion of its course. Outside of this line the whitish calcareous mud, also called Globigerina mud, prevails and extends probably under the greater part of the ocean. The silicious sand is replaced to the southward of the Vineyard Islands and off the eastern end of Long Island by a greenish or bluish mud, known by the navigators as the Block Island Soundings. Similar mud is found off Sandy Hook, in a range of depressions known as the mud-holes, which form a leading mark to find the entrance of New York in thick weather. In the neighborhood of New York a few rocky patches are found, which require investigation. Near Cape Fear, also, rocky bottom is sparingly found, affording a foothold to some Corals, Gorgonians, and Sponges. Otherwise the sand is pretty uniform in constitution, varying only in the size of the grain.

A remarkable deposit of green sand is found on the inner edge of the Gulf stream off the coasts of Georgia and South Carolina. The bottom consists here chiefly of living or dead Foraminifera, the chambers of the latter becoming filled with a silicate which injects even the finest ramifications of the canals of the shell. At first yellow, it gradually turns green, at the same time the shell proper decays and breaks off, leaving a cast, which by attrition or conglomeration with others often loses the characteristic form of a cast. Sometimes black pebbles are found, of which a section shows plainly the origin, due to an agglomeration of casts of Foraminifera. The dredgings made by the Coast Survey in the Straits of Florida, have revealed the existence of a large bank or deep sea plateau off the Florida reef, consisting of a highly fossiliferous limestone, still in process of formation from the numerous shells, Echinoderms and corals, mostly new to science, which live on it at a depth of from one hundred to three hundred fathoms. Between this plateau and the reef, the bottom consists of the detritus of the reef, more or less finely comminuted, and not rich in animal life. In depths beyond the three hundred fathoms line, but with considerable variation in its limits, we find again the Globigerina mud, which also fills the greater part of the Gulf of Mexico in deep water.

The Coast Survey intends to prosecute these researches next year with increased means.

Dr. A. S. Packard, Jr., gave an account of the development of *Limulus Polyphemus*, the Horse-Shoe crab.

The eggs are laid near high tide mark, loose in the sand, late in the spring and during June and July. The larva hatches in about six weeks. Previous to hatching it bears a striking resemblance to the Trilobites, and may also be compared with the fossil Carboniferous King Crab, Bellinurus. It passes through a very slight metamorphosis, consisting of the addition of three pairs of abdominal lamelliform feet, and is remarkably similar to the larval trilobite. For this and other reasons he considered the Pœciloptera, or King Crabs and their allies, the Eurypterus, Pterygotus, etc., to be a subdivision of the Branchiopoda, which also includes the true Phyllopods and Cladocera.

He considered this order as having flourished most in Palæozoic times, the living representatives being the remnants of an extensive group, the missing links of which are to be sought among the Silurian, Devonian, and Carboniferous strata. He regarded the known forms as generalized types, which preceded in time and in process of evolution the Decapod Crustacea. The Branchiopoda pass through, either in the egg or in the larval state, a nauplius form; and to such a form, probably living in the Laurentian seas, he would trace the ancestry of the group, the order of descent being by perhaps three or more parallel lines. Huxley has compared Pterygotus to the zoëa of a crab. The speaker extended this apt comparison to the higher Branchiopoda, and the comparison does not apparently fail when applied to Limulus, the larva of which is nearer a zoëa than a nauplius; there being a pair of compound eyes, and a distinct abdomen, bearing three pair of legs, while the cephalothoracic appendages are comparable to the feet of the zoëa of the Decapods, which become by subsequent moults, mouth-organs, the true thoracic feet being added at the first moult. He likened the Neuroptera and Orthoptera, and, among Lepidoptera, the family Bombycidæ to the Branchiopoda, the generic forms often widely differing among themselves, being in fact generalized types, the links connecting them having probably perished in past geological periods.

Dr. Packard also announced the recent discovery at Salem of a new species of Pauropus, which he named *Pauropus Lubbockii*, in honor of the discoverer of this most remarkable type of Myriapods, which, as Lubbock has remarked, combines the characters of the

Myriapods with other insects, while its antennæ are bifid, a crustacean character.

Speculating on the probable ancestry of insects (including the Arachnids and Myriapods) he would trace their descent from a form resembling in some respects the hexapodous larva of Pauropus, which seems reproduced in larval Myriapods (Julus); in larval Arachnides (mites); and larval and degraded forms of many insects (such as the flea, louse, bat-tick, Braula, Chionea, female Anisopteryx, Œceticus, the Thysanura, etc., etc.,) all showing a strong tendency to assume a hexapodous Podura-like form, which may be compared with the Nauplius form through which Fritz Müller, Dr. Dohrn, and Haeckel consider all crustaceans to pass. For this ancestral form he had proposed the term Leptus, from the fact that like Nauplius, which was first supposed to be an adult Entomostracan, the larval form of Trombidium had been described as a genus of mites under the name of Leptus, and was supposed to be an adult. The Leptus was hexapodous, and bore a general resemblance to the Poduræ, and the young of Pauropus, though the body (especially the abdominal portion) was not segmented. He thought there were several parallel lines of descent, diverging from some forms such as the Tardigrades or Linguatulæ, or both, and probably others, which again might have descended from some terrestrial worm like Peripatus, and other generalized types of worms.

Prof. Edward S. Morse made a few remarks on the structure of the common sipunculoid worm of the coast, ***Phascolosoma.***

It occurs in the greatest abundance at Eastport, Me., living in the shells of *Dentalium* principally, though found in other species. The worm takes possession of the empty shell, and partially plugging it with hardened mud, forms a constricted aperture. Owing to the translucence of the animal, the internal organization can be studied to advantage. He referred to certain features in its structure, and in the character of its earlier stages, as throwing additional light on the affinities of the Brachiopods with the Vermes.

Dr. Samuel Kneeland gave an account of a visit made by him during the past summer, to the country lying about the upper Mississippi. He described the beauty and attractive-

ness of the scenery and healthfulness of the climate. He also exhibited and presented to the Society valuable specimens of minerals collected during his visit, and referred to this section of the country as one possessing peculiar attractions for the students of Natural History.

Rev. R. C. Waterston, by invitation, spoke briefly of his recent visit to California, and was requested to make a more extended statement at a future meeting.

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December 7, 1870.

Prof. A. Hyatt in the chair. Forty-four persons present.

The following is a brief abstract of a paper which will appear in full in the future pages of these Proceedings:—

### On the Glacial Period in New England. By Rev. J. B. Perry.

Mr. Perry introduced his communication with the remark that it contained the main results of his studies in this direction during the past fifteen years.

Proceeding at the outset to give a brief account of the *indications* of ice-agency, he first enumerated those furnished by the *underlying rock-masses*. These are *erosion*, as of lake-beds, and the like; *planation*, as almost every newly-bared surface indicates; also *striation*, as witnessed by the countless scratches and furrows on the rocky floor of the country.

Next were brought into view the facts indicative of ice-agency from the *overlying material*. These are such as the *composition* of typical drift, it being generally different from that of the subjacent rocks; its *derivation*, it having been for the most part brought a short distance from the north; as well as its *condition*, it invariably being a heterogeneous jumble.

Indications from *incidental phenomena* were likewise noticed; such as the *accumulation* of travelled matter, moraines being an instance;

the *location* of perched rocks, they being often found in extraordinary abundance on isolated summits; and the *position* of certain old beaches, as that of the shore-remains at Ripton, Vermont.

These, and other kindred facts, having been advanced as decisive proof of glacial agency, Mr. Perry proceeded to enquire, under what form, according to the evidence, the ice must have acted? Were the phenomena in question produced by icebergs, as supposed by Sir Charles Lyell and the geologists of his school, in connection with a general *depression* of the country? The several cited effects of glacial agency having been passed in review and subjected to close scrutiny, it was found that the larger proportion of them could never have been produced by icebergs; that the remainder may be better explained in another way; that for the most part the theory of depression is entirely unsupported by facts, and therefore to be discarded.

The iceberg hypothesis having been considered, Mr. Perry next inquired whether the results were produced in connection with a general *elevation* of the country, at the close of the Tertiary Era, as held by Professor Dana. It was shown that the theory of elevation is also a mere supposition, wholly unauthorized by positive evidence; that the facts relied on for its support, as change of climate, the existence of pot-holes, of fiords, and of aërial deposits now lying beneath the level of the sea, can all be more satisfactorily explained in the light of another view; and that instead of an elevation of the land there was perhaps far more probably a depression of the ocean.

Having discussed the inadequacy of the theory of elevation, Mr. Perry finally noticed the theory of *glaciation* substantially as proposed and defended by Professor Agassiz. He inquired whether all the main facts passed in review be not just what we must suppose they would have been in case the country had been covered by an immense sheet of ice moving slowly southward. In the light of this view, he indicated how the several classes of effects indicative of ice-agency receive a simple and easy explanation, and especially that the more difficult phenomena, as perched rocks, elevated pot-holes, the Ripton Beach, the Berkshire boulder trains, and other kindred points, are not anomalies, but special instances and illustrations of the working of the great agency characteristic of the glacial times.

Dr. W. G. Farlow exhibited a collection of Marine Algæ, of the eastern coast of the United States, and remarked on their geographical distribution.

The coast may be divided into three regions in which the algæ present a marked difference. In the first division, extending from Cape Cod north, the Melanosperms predominate and are the distinguishing mark. Of these, although the Fuci are more numerous, the Laminariaceæ are the most striking. The *Laminaria longicruris*, not rarely eighty feet long, is very abundant. It has never been found south of Cape Cod. In Europe it is found sometimes on the north of Scotland and on the coast of Norway. The *Agarum Turneri*, the sea-colander, another of the Laminariaceæ, is peculiar to the coast of America north of Cape Cod. Its only other habitat is Alaska.

Of the Rhodosperms the *Euthora cristata* is very abundant, much more so than in any other part of the world. The beautiful *Ptilota serrata* may almost be said to be peculiar to our coast. Its only other habitat is Norway, where it sometimes occurs. The *Halosaccion* is found north of Rye Beach in abundance, but as its fruit has never been seen, its scientific position is still doubtful.

The Chlorosperms, although rich in species, are limited to few genera, the *Cladophoræ* outnumbering all the others. The beautiful *Siphonaceæ*, the highest of all the Chlorosperms, are represented only by *Bryopsis plumosa*.

The marine flora of New England resembles very strongly that of the north of Scotland and Norway.

The moment we pass south of Cape Cod we have a vegetation most strikingly like that of the Adriatic in the neighborhood of Venice. *Dasya elegans*, *Solieria chardalis*, and *Polysiphonia variegata* are distinguishing algæ of both Long Island Sound and Venice. Besides these we find the extremely beautiful *Grinnellia Americana*, perhaps our most beautiful alga, and only found in Long Island Sound. The Chlorosperms of this region are few in number and uninteresting in character. The Melanosperms are by no means as numerous, either in species or individuals, as north of Cape Cod. But in Greenport harbor we first find in a growing state a representative of the tropical genus Sargassum, *Montaguei*, while south of Nantucket large masses of *Sargassum bacciferum*, the common gulf-weed, are found floating, probably brought from the Gulf of Mexico by the Gulf-Stream. The

Long Island algæ, it will be seen, are distinguished by the predominance of Rhodosperms.

The coast, from New Jersey to South Carolina, is a desert as far as algæ are concerned. In Charleston harbor we find a few algæ, principally *Grateloupia Gibbesii* and *Delesseria hypoglossum*, but when we reach Key West we find a subtropical flora forming the third region into which our shore is usually divided by algologists.

Here the Fuci are wanting, and the Melanosperms are represented by *Sargassum* and several genera of Dictyotaceæ. The Rhodosperms are very numerous and interesting, but it is in the number and highly organized character of the Chlorosperms that this region surpasses the two previously mentioned. The Siphonaceæ are numerous and extremely beautiful, forming large green patches near the shore, and resembling Lycopods and the larger mosses. They even have a creeping subterranean stem, as the Lycopods, by which they are able to remain fixed in the sand where very few algæ can grow.

Dr. Farlow closed by showing specimens and explaining the structure of the calcareous Chlorosperms of this region called corallines. The genus *Udotea* and *Penicillus* seem to be badly limited by Harvey. In *Udotea flabellata* we have the type of that genus. The filaments here branch at their end into root-like expansions, forming the surface of the frond, and the calcareous coating is uniform. In *Udotea conglutinata* the filaments are undivided at the end, but in the stipe give off lateral root-like processes and their calcareous coating is cribriform. In *Penicillus capitatus* we have a precisely similar structure, except that the calcareous coating surrounds each filament, while in *Udotea* we have it uniting the filaments into a flat frond. But in *Penicillus Phœnix* we have the connecting link where the filaments are united into plates by threes. Dr. Farlow showed a new species of *Udotea* from Cuba nearly related to *Udotea conglutinata*.

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## December 21, 1870.

The President in the chair. Twenty-six persons present.

### Glacier Theory of Drift. By Dr. C. T. Jackson.

Dr. C. T. Jackson made a few remarks on the conditions required for the formation of glaciers, and explained why he had not been able to adopt the glacier theory of drift phenomena.

He would welcome any reasonable theory to account for the origin and distribution of drift, since there were serious objections to all theories that had thus far been proposed.

The conditions absolutely necessary for the formation and movement of glaciers had not been proved to have ever existed in this region, or anywhere, except in mountainous countries situated in a temperate climate. We require, first, that there should be a sufficiently elevated temperature to provide for abundant evaporation of water; secondly, that there should be high mountains reaching the regions of perpetual snow, and such variations of temperature as would secure alternate freezing and thawing, so that *nevé* or half melted snow, from which glaciers are formed, should be produced. Warm valleys and high mountains were then absolutely necessary for the production of glaciers. A general cooling of the globe to a temperature below freezing could not result in the formation of any glaciers, even if such a general reduction of temperature took place.

If the earth was ever cooled to so low a temperature we must naturally inquire how it ever became again heated. Astronomy does not justify any such hypothesis, and geological facts seem also to disprove it. We can understand the theory of Fourrier, of a slowly cooling globe, and his results are that the earth is losing but a small fraction of a degree of heat per century, owing to the imperfect conduction of heat by the thick crust of rocks. It is also shown that in the epoch immediately preceding the drift (the tertiary), that a tropical temperature pervaded the now temperate regions of the earth. The fossil remains of monkeys, tigers, and other intertropical animals in the north prove this fact beyond question.

If the earth, in our now temperate regions, was at the tertiary period heated to a tropical temperature, as all the facts of geology prove, how could it have been suddenly cooled to so low a degree as to allow the formation of three or four thousand feet thickness of ice in New England and other temperate countries? No facts or principles in astronomy point to any cause for such a marvelous change. Physical principles give such an assumption no support, and it derives none from paleontology and fossil botany, which indicate a higher, but not a lower, temperature than now exists in temperate and even polar regions. Witness the abundant remains of elephants in the northern Siberian soil; Mylodons in the soil of Oregon; monkeys, tigers and other tropical animals in the tertiary of England and other northern countries. These all indicate a warmer

climate at the north ages ago. Now what physical, cosmical, geological or astronomical causes can be cited to explain a cooling below zero of the earth in those regions?

Suppose it could be proved that the whole earth was reduced in temperature to that low degree, what would follow? There would be no evaporation of water adequate to the formation of snow thousands of feet deep, and hence no glaciers could be produced even were the other conditions also existent.

Furthermore, it has been shown by recent experiments in France, that if the rocky crust of the globe should be cooled universally below freezing, all the water now existing on the earth's surface would be absorbed by the pores of the rocks, for the water of our globe is kept at the surface only by the internal heat of the globe, and cannot penetrate beyond a depth of two miles without being returned as steam, which condenses into water again.

Indeed, it has been proved that if the interior of the earth consists of rocks, and the temperature of the whole earth was reduced to the freezing point, that five times the quantity of water now existing, as oceans, lakes and rivers, would be absorbed by the rocks, and every trace of humidity of the earth's surface would disappear; and furthermore, that the porosity of the rocky strata would be equal to the absorption, also, of the entire atmosphere, so that the earth would be in the condition of the moon, without either water or air.

This would hardly be a state of things favorable to the formation of glaciers.

We need not go so far as this to render improbable the existence of ancient glaciers in New England; for the considerations before advanced are sufficient to create at least serious doubts, since the requisite conditions for their formation are wanting.

Glaciers form from partially melted snow on high mountains. In Switzerland their lower limit, or line of perpetual snow, is nine thousand feet elevation above the sea. A continuous supply of snow, from evaporated water in warmer regions, is required to keep up the supply in the elevated portions of the mountain.

The movement of glaciers is determined by the slopes of the mountains, the ice moving, as proved by Forbes, like a soft solid in a trough.

It is evident, also, that glaciers descend from mountains *qua-qua versal*, that is, go in all directions as allowed by the mountain slopes and gorges, and make their grooves and scratches in the rocky

bed or channel and carry their debris in all the directions pursued by the moving glacier. This does not correspond with the facts observed in drift scratches and drift deposits, for they are invariably from north to south, deviating a little from that general course, the most common direction of drift-scratches being from north-west to south-east in Maine, New Hampshire and Massachusetts, while in Rhode Island they run due north and south.

Neither the drift scratches nor the drifted materials bear any such relations to the hills and mountains as to indicate a glacial origin or movement.

American geologists are more inclined to adopt the theory of ice floes, as a drift agency, and the two or more sets of drift scratches, in the ledges, seem to be accounted for by the changing course of tidal currents, moving the grounded ice and gravel on the bottom. It should be remembered that eight-ninths of all floating ice is below the surface of the water, and that ice frequently grounds at the present time on the Grand Banks, the bottom there being undoubtedly grooved in the same manner as the rocks were in the drift epoch. Dr. Jackson observed that the highest geological authorities rejected the glacial theory of drift, and he need but name De Luc, the veteran geologist of the Alps, Leopold Von Buch of Berlin, L. Élie De Beaumont of Paris, the most eminent geologists the world has ever seen, as stern opponents of this theory.

In response to the invitation of the President, Mr. Perry discussed at some length the objections urged by Dr. Jackson.

As to the assertion that the glacier theory is a mere hypothesis, and that the various forms of this theory have been one after another demolished, he would frankly admit that this explanation, in a certain sense, is an hypothesis; it cannot be proved true by a mathematical demonstration; no more can it be sustained by one kind of evidence alone. But that it is a *mere* hypothesis, he was not so ready to grant. There is a great variety of considerations bearing on the subject; the argument is cumulative. So, too, if we find, upon examination, that the main effects to be explained are substantilaly what we must suppose they would have been in case the country were once covered by an immense blanket of ice; that there are also facts indicating the prevalence of agencies capable of forming such

a wintry mass; and that the so-called counter-facts are equally susceptible of explanation according to the glacier theory, we surely have the best kind of demonstration possible in the nature of the case. Should this prove to be the fact, though he could only just touch the points now, the glacier theory must be regarded as far more than an empty hypothesis, and the various forms of its so-called demolition may be counted for nought.

Another objection claiming notice is the alleged weight of authority against the glacier explanation. Von Buch, the greatest geologist of the age, it is urged, entirely discarded this hypothesis. The same is true of other eminent and able investigators. This argument might be good, if eminent men had never done foolish things. The opinions of distinguished savants have presumptive evidence in their favor, so long as there is nothing against them, and they are to be received not as their dicta, but because they are reasonable. While we are to have due respect for their legitimate decisions, we are also to remember that in some cases their judgments are not worth a straw; that we are to recognize only the weight of their evidence as authority. In given points and under certain circumstances the ablest investigators have made the grandest mistakes. Most people, after passing a given age, cling tenaciously to the theories they adopted when they were younger. Early manhood is the period of inspiration. It is because young men are constantly coming upon the stage that the world moves. When a little older, these same persons, with rare exceptions, stand in the way of progress, and it must be confessed that in so doing they sometimes exert a wholesome influence, and sometimes—not. Now Von Buch (for whom he had a high veneration) was already somewhat advanced in years, and had his predilections fixed, when the youthful Agassiz first advanced the glacier theory in explanation of the drift phenomena. It is not therefore surprising that he, and other eminent geologists similarly situated, rejected, and have continued to reject it, outright.

Several other objections urged have respect to the conditions supposed to be necessary to the existence and action of glaciers. These are evaporation, congelation, and inclination. As these favorable conditions occur in Switzerland, so do ice-streams as their result. And the implication is that these favorable conditions have not existed in New England, and consequently that the theory of an extensive ice-sheet moving over the region is a myth. Now he would not say that the same conditions existed here in the past as are now

found amongst the Alps; he would simply ask whether there were conditions capable of producing the effects in question.

On the one hand, then, are there any facts indicative of conditions favorable to a sufficient supply of moisture? In order to the formation of extensive ice-sheets, the water must have come mainly from the ocean. Strange to say, there is the best proof that volcanic agency was very active for some time, about the close of the tertiary period. The extensive masses of erupted matter on the Pacific coast and in Central France are, at once, instances and evidence. In connection with these disturbances, submarine volcanoes were no doubt prevalent. These must have heated the waters in the great oceanic basins, and their action being for a long time continued, the evaporation would be immense and continuous, furnishing a supply of moisture fully equal to the demand.

On the other hand, it may be asked whether there be any facts indicative of cold at the period in question. It must be admitted that there is no positive evidence of an elevation of the northern part of North America at that time, and that thus the condition of congelation now existing in Switzerland did not probably prevail in this region. But there are cosmical facts suggestive of a degree of cold equal to that required in the production of the effects demanding an explanation. Without dwelling on the supposition that the earth may have been passing through a colder region of space, or on the probability that the sun is a variable body, affording sometimes more and sometimes less heat, he mentioned three points :—

1st. Variation in the obliquity of the earth's axis to the plane of the ecliptic.

2d. Variation caused by the absence of the perihelion in connection with the precession of the equinoxes ; and

3d. Variation in the eccentricity of the earth's orbit.

While no one of these variations alone may be sufficient to account for the cold of the ice period, we should remember that they occur in cycles, which may be represented in round numbers by 10,500, 26,000 and 234,000 years each, and that in the course of many revolutions all the tendencies suited to produce cold must have coincided, and that thus, by the combination of intensities, there would result a great winter of the ages. Now let evaporation take place at the same time, and for a long while (and I have evidence bearing on both these points), also let the vapors from the heated basins of the ocean be borne over the cooling regions lying to the north, we have just the

conditions suggested by facts, and needful to the glaciation of the country. Whatever theory, in short, we may adopt, in regard to the ice period, the facts of astronomy compel us to admit changes of temperature—great æonian summers and winters—in the progress of the globe. And geology tells the same story; for instance, the carboniferous period followed by the permian, the miocene tertiary by the period of drift.

Again, however, it is said that, even if ice were formed, its motion would be impossible; there being no great elevation of the continent, an inclined surface like that of Switzerland must have been wanting, and thus the necessary condition of motion. Let us suppose North America a level plane, and that, vapors condensing, a vast amount of moisture is deposited upon it. What would be the result? This accumulation of water cannot remain heaped up even on a dead level, to say nothing of an inclined surface; it must flow off. The case is not different, even if it be congealed. Ice, as influenced by gravity, would have the same tendency to motion as water. If, now, the cold on the extreme north be greater than elsewhere, there would be a barrier to motion in that direction. If melting take place to some extent on the upper surface and the southern side, if moisture from the snows melting at midday percolate the ice which beneath the surface was much below the point of freezing, if gravitation does its legitimate work on a mass five or six, not to say ten thousand feet in thickness, surely some elements of motion are furnished, in case the ice-sheet were resting on a plane, and still more, if there were, as was no doubt the case, on the whole a gentle inclination toward the Gulf of Mexico. Indeed, under such conditions, motion southward would be inevitable.

But it is also objected that, such cold prevailing, the rocks would absorb all moisture, and the surface of the earth be left, like that of the moon, without air or water. It should be remembered that the cold of the glacial period was not necessarily so intense as has been sometimes asserted, very extreme cold not being the condition most favorable, all things considered, to the production of glaciers. So it should be borne in mind, that as soon as snows and ice began to mantle large tracts of land, they would be largely proof against external cold. Meantime, the internal heat being as intense as ever, the temperature of the water that penetrated the rocks would be raised, and thus an extreme absorption of moisture prevented.

Again it is asked, by way of objection, how, in case intense cold

prevailed during the glacial period, a return of warmth was secured? If the astronomic agencies already referred to be sufficient, when taken in combination at their concurring points of greatest intensity, to occasion a winter of the ages, the same agencies would be sure to bring, in the natural course of things, an alternating æonian summer. This might be a long while in coming, and the glacial period was probably of considerable duration; still it must finally appear, even as summer invariably succeeds to winter.

Once more it is objected, that an ice-sheet moving southward could not have produced the variations observable in the direction of the striæ. It seems to be forgotten by many that the glacial mass must have varied in thickness during the different portions of the ice-period. When it was at its acme, the direction, as a rule, must have been north-southward. In the closing portion of the period, as the thickness gradually diminished, the direction would be more largely influenced by the inequalities of the country. Local glaciers finally becoming predominant, their direction must be down the existing valleys; thus in a great variety of directions, as in the Green Mountains, predominantly east-west and west-east, leaving furrows and grooves to correspond. Accordingly an ice-sheet, varying in thickness at different stages, would produce just the variations referred to, while they are hardly to be explained by resort to any other known agency.

The principal objections urged by Dr. Jackson having been considered, and, as it is thought, fairly met, the hypothesis proposed in place of the glacier theory may be briefly noticed.

And, first, some geologists have maintained that the effects, referred to the agency of ice, were produced by the action of flowing water. In respect to this hypothesis, it may be simply remarked that, so far as we know, flowing water never produces, and is in no wise able to produce, some of the most characteristic features of the glacial times. In many cases the effects of its action are just the opposite of those requiring an explanation. For instance, flowing water tends to efface, not to produce, the polished surfaces met with all over the country, whenever the underlying solid rock is freshly laid bare.

Again, and this is said to be the prevailing view, icebergs and ice-floes are invoked as the all-sufficient cause of the phenomena. As to the argument involved in "the prevailing view," he would simply quote, "Broad is the way of delusion, and *the many* find it." To the

hypothesis itself he could only devote a word. That bergs from an arctic continent did not bring the drift, is evident from the fact that it was to a large extent derived from rocks lying only a short distance to the north of the respective places in which it is now found. It is equally clear that the great mass of typical drift was not formed by local glaciers, since it spreads in one continuous sheet, having common glacial characteristics, over the whole region, while it is itself in places uncomformably overlaid by the debris of local ice-streams. That it was not dropped by slowly-thawing icebergs, either as stranded or in motion, is also apparent, since matter thus disengaged would fall particle by particle and be regularly arranged or semi-stratified, and not left in a jumble. So it is manifest that icebergs did not erode, polish and striate almost the whole rocky floor of the country, since the drift markings are made obliquely across meridional ridges, ordinarily without the slightest reference to differences of level. Indeed, for icebergs to make continuous furrows over high hills and through deep intervening valleys, irrespective of the ever-varying inequalities of surface, would be a far greater marvel than the wonders to be explained.

Having thus discussed some of the objections to the glacier theory and having briefly shown why he had never been able to adopt the iceberg hypothesis, he desired to bear witness to the great number and accuracy of Dr. Jackson's observations of drift phenomena, and to assure him of his kindest personal regard.

After Rev. Mr. Perry's answer, Dr. Jackson said that Mr. Perry had made an excellent defence of the glacial theory, but had not removed his objections. He did not see how volcanoes, in distant countries, could furnish the moisture required for the production of thousands of feet of ice in New England, nor could he understand how a glacier could rise from the bottom of Lake Superior, which is more than six hundred feet below the sea level, or how glaciers could exist in Brazil.

To the additional objections suggested by Dr. Jackson, Mr. Perry briefly replied.

As to the statement that, however effective volcanic agency may have been elsewhere, at the close of the tertiary period, it could have had little influence in New England, since there were no volcanoes

here, he would say that there was evidence of a great disturbance, even in this neighborhood, at the time in question. The tertiary beds of Martha's Vineyard are tilted up at a high angle, and there are facts indicating that the uplifting took place not far from the beginning of the ice period. The strike of the beds suggests that the agency was also submarine; that thus the waves of the Atlantic were probably greatly heated, and the conditions furnished for immense evaporation.

The question raised in regard to the evidence of glacial agency in Brazil, requires a moment's notice. As to the statement that the extension of the glacier hypothesis to that region is one of the greatest objections to it, he would merely say, that whether the extension be justifiable or not, it in no wise militates against the existence of ice agency in New England. As he had never visited the region, he was not prepared to discuss features which can be adequately understood only after the closest examination. The presumption, of course, is that Professor Agassiz has only spoken after due consideration, and that he is abundantly able to defend his view of the matter.

The former occurrence of ice agency in the basin of the Amazons being granted, it may be asked whether it were synchronous with the existence of drift agency in North America. After all he could learn on the subject, the observations thus far made seemed to him insufficient for the decision of the question whether the drift agency of the northern hemisphere was simultaneous with that of the southern, or subsequent to it. For that reason, while he might sometimes speak of one set of cosmical agencies, and sometimes of another, he was indisposed to say, because he did not know, just which prevailed; only that, under given circumstances, they were abundantly sufficient for the production of the facts requiring an explanation.

In respect to the assertion that, the bottom of Lake Superior being lower than the surface of the ocean, ice could not have moved from that basin seaward, he would say that the implied objection seems to rest on a misapprehension of the condition of things during the ice period. Let us remember that the ice, for instance, on the north shore of the lake was probably from five to ten thousand feet in thickness; that it was pressed by a portion equally thick, if not thicker, adjoining it on the north, and this by another and another; that the basin, which was probably far more shallow at the beginning of the ice period, would be filled with ice, and greatly deepened, because of the immense force pressing from

above and from the north ; that thus the ice at one time in the basin must slowly pass over the southern shore, as it gradually gave way to the irresistible *vis a tergo* incessantly at work on the northern shore of the lake. With a caution against the indiscriminate application to ice of the conditions peculiar to the motion of water, he would illustrate the matter by a familiar instance. Water passes from Lake Superior into Lake Huron, and yet the bottom of the former is far lower than either the surface or the bottom of the latter. If there be no valid objection to this statement, he failed to see any reasonable difficulty in the supposition that ice, during the glacial period, passed from the basin of the great lake southward toward the Gulf of Mexico; indeed, some of the very channels which it probably eroded are visible to-day.

Dr. Charles Pickering said he found it difficult to adopt the view of Dr. Jackson, as it supposed the boulders to have been brought from a great distance. In the localities most familiar to him, he had found the boulders not far removed from their original position—a few miles only.

He thought land and water might be so distributed as to make an equal temperature on the surface of the globe. New Zealand is in a somewhat high latitude, yet produces tree ferns. At Cape Horn it is difficult to determine whether the climate is perpetual summer or perpetual winter; snow falls at intervals throughout the year, but quickly disappears, leaving the country always green; vegetation continues uninterrupted, and the natives go without clothing.

Great geographical changes have taken place since the earlier geological periods, for the crest of the Andes was once the bottom of the ocean.

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## Section of Entomology. December 28, 1870.

Mr. J. H. Emerton in the chair. Nine members present.

Mr. Edward Burgess exhibited a drawing of peculiar cutaneous muscles intersecting the nerve centre of the larva of *Darapsa myron*, and crossing just before the third thoracic ganglion, and causing an expansion or spreading of the gan-

glionic commissure at that point. He had seen a drawing of the same muscle (numbered 18) in another species of larva in a paper by Lubbock.

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## January 4, 1871.

The President in the chair. Thirty-six persons present.

John P. Payson of Chelsea, John D. Billings of Jamaica Plain, G. Brown Good of Cambridge, Charles M. Sumner, M. D., Samuel Henshaw, John S. White, John Prince Knight, S. Gardner Lewis, Edward Wigglesworth, Jr., M. D., and Thomas C. Chandler of Boston, were elected Resident Members.

Mr. Henry E. Dresser of London, Josiah Curtis, M. D., of Knoxville, Tenn., and Thomas F. Perley of Bridgeton, Me., were elected Corresponding Members.

The following paper was presented:—

### On Two Fowls with Supernumerary Legs. By Thomas Dwight, Jr., M. D.

Two specimens of three-legged fowls were received by the Society on December 28th, 1870, and on January 2d, 1871, respectively. Each had a third misshapen leg, which did not reach the ground, suspended between the other two; but the anatomy of the malformation was entirely different in the two specimens.

The one first received (Catalogue, No. 1208) was loaded with fat. The third leg was suspended by a rounded mass of fat, in the median line below the highest caudal vertebra, and contained no bone for the first inch. A rudimentary ligament (the upper end of which was perhaps slightly muscular) descended from the ischial spine of either side, each to be inserted into one of the two spines by which the limb began. Otherwise the pedicle was

merely fat and skin. The bony structure is as follows: (Figure 1). First come two slender spiculæ of bone, the left ($a$) nearly three-quarters of an inch in length, the right ($a'$) somewhat shorter, connected by a narrow transverse piece. These are continuous with a single irregularly cylindrical bone ($d$) an inch and a quarter long, having at either end a protuberance directed forward. To this, another bone ($c$), seven-eighths of an inch long, is anchylosed at a right angle so as to point forward. At the proximal end this has a small process jutting out on either side, and below it shows a commencing bifurcation. Next come the phalanges. On the right there are two ($d^1$). On the left the proximal phalanx ($d$) may be said either to bifurcate or else to have an outgrowth from its right side; each of these subdivisions has a small terminal phalanx which is not so well developed as that of the right toe. The proximal phalanx has also a slight knob on its outer and lower side opposite to its bifurcation. This extremity was covered with fat and skin, having no other tissue. There is considerable difficulty in naming the various parts. To begin with the phalanges; $d'$ from its number of segments is evidently the hallux, the sole representative of the right foot. If we hold that $d$ bifurcates we have two left halluces, which is absurd; but if we consider the median toe to be an outgrowth from $d$ we shall have a left Hallux and a second toe.

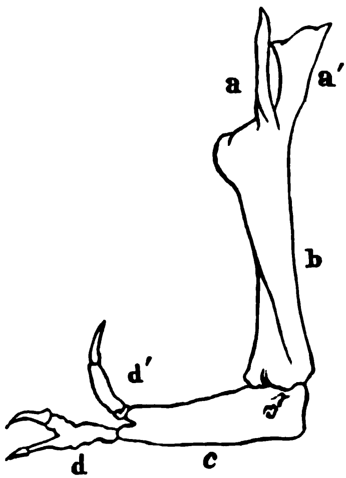

Fig. 1.

$C$ evidently represents a double metatarsus and has at its lower end somewhat the appearance of being inverted. There were remains of joints between this bone and the phalanges, but above, all the segments are coössified. The segments $a$, $a^1$, and $b$ are the most difficult to identify. It might be argued that $b$ represents the two

tibiæ, and $a$ and $a^1$ the two femora, which would account for all of the various segments; but while it is not uncommon to have a single limb become double towards its extremity, it is perhaps unheard of to have the single limb with a double origin; still more so to have it single in the middle, as at $b$, and double at each end. I think it more natural to consider $b$ a fusion of the two tibiæ while $a$, and $a^1$ are prolongations of the fibulæ upward.

The other specimen (No. 1209) before dissection was not very unlike the first. The supernumerary leg was longer, thinner and separated by a greater interval from the body. There were but two

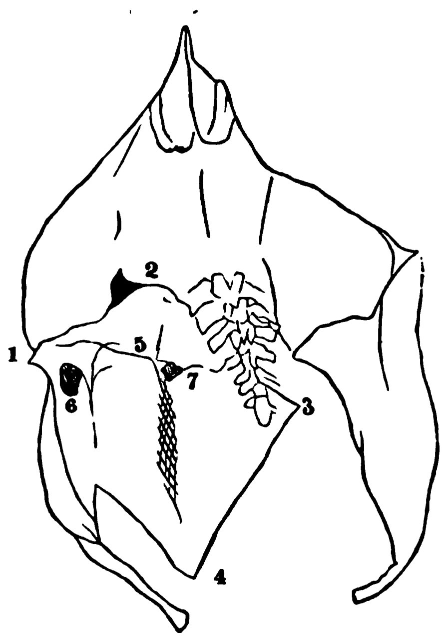


Fig. 2.

toes, which were of an equal number of segments and of nearly equal size. The pelvis, after removal of the soft parts, was found to be very peculiar. The sacrum is deflected to the right and the caudal vertebræ very markedly so. (Fig. 2). Between the renal portion of the

left ilium and the left ischium on one side, and the extremity of the sacrum and caudal vertebræ on the other, two plates of bone are inserted, uniting with one another at a right angle by a transverse line of union (1, 2, 3, 4). The upper, nearly horizontal (1, 2, 3), plate and the deflected vertebræ close the space between the two iliac bones almost completely, while the lower vertical plate (2, 3, 4) shuts off about two-thirds of the opening behind.

The transverse line of union of the two plates (1-3) is an inch and a half long, with a well marked process at each end. The outer surface of the horizontal plate presents little to be described. The vertical plate has a ridge (5-4) dividing it into a right and a left portion, each of which is roughly triangular. There is an oval foramen (6) at the outer superior angle of the left portion, and a smaller one (7) at the left upper angle of the right portion. Viewed from within we find the upper part of the interposed bone to be divided by a framework into two fossæ, of which that to the right is much the larger, and into each of which one of the lately described foramina opens. A careful comparison with the normal pelvic bones will show very strikingly that the upper plate of the abnormal bone corresponds to the renal portion of the ilium, and the lower to the ischium. And what is more interesting is that the ridge on the outer side of the latter and the framework on the inner side of the former, together with the general lateral symmetry of the two halves, make it probable that they represent the fused supernumerary bones of the two sides. The viscera had been removed before the importance of these homologies was evident, but the well marked additional renal cavities make it very probable that there was at least one additional kidney.

A muscular bundle, having a circular attachment about half an inch in diameter, arose from the outer aspect of the vertical plate, and at a distance of an inch and five-eighths from its origin, was inserted into the summit of the third leg. (Fig. 3). The chief bone (*a*) is two and a half inches long, compressed laterally above so as to be very slender, but expanding below to a breadth of a third of an inch; its lower end is bent forward and has a groove on the anterior surface, the posterior being plane. The lower extremity is bifid. On the anterior aspect, near the lower end, there is a small elevation shaped like a compressed V inverted. The superior end of the bone is surmounted by a delicate process which, turning suddenly to the right, ends in a knob. The bone appears to represent the metatarsus of

the two legs turned on its long axis so that the posterior surface is in front. From each of its two inferior terminations arises a toe (*b*) consisting of four phalanges, the right one being a trifle the longer, and each with the plantar side above. These, therefore, are the fourth digits of different feet. Although the muscular fibres ceased at the upper end of the bone, tendons were continued down the limb, and the flexor tendons going to the last phalanges were very distinct; on the dorsal aspect the arrangement was not so clear. As these tendons were more or less united to the periosteum of the long bone (*a*), the muscle can have had little action except to raise the whole limb at once. There were several good-sized blood vessels, and the whole limb had the appearance of a much higher degree of organization than that of the other specimen. These are examples of what Vrolik calls inferior lateral duplicity.

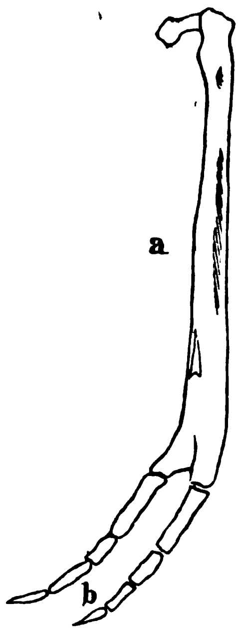


Fig. 3.

As anomalies of this class are by no means fully understood, and as it is very rare to find two cases which resemble one another, I have thought it more for the good of science to describe the appearances accurately than to indulge in speculations which, in the present state of knowledge, must rest on imperfect data.

## Some Interesting Phenomena Observed in Quarrying. By W. H. Niles.

In working a quarry at Monson, Mass., some phenomena have been observed, which I trust will prove to be of scientific interest. For a few years, Mr. W. N. Flynt, proprietor of the quarry, and his foremen, have observed spontaneous fractures, movements and expansions of the rock. Mr. Flynt called the attention of some persons interested in science to these phenomena, yet no one made them a

subject of special study. In November, 1870, he first called my attention to them by quite a full account of what had been observed. To me the facts were both new and interesting, and I have since made visits to the locality, that I might personally observe and study them. With the consent of Mr. Flynt and his foremen, I shall, in the present paper, give some account of the facts they have narrated to me, as well as of my own observations, in order that the subject may be more fully elucidated.[1]

The quarry is located in the belt of gneiss, which lies east of the red sandstone of the Connecticut Valley. From the city of Springfield, Mass., the quarry lies east about 4° north, and at a distance of about twelve miles and a half in a direct line. In going towards the quarry from Springfield, at a distance of about seven miles and a quarter in a direct course and in the town of Wilbraham, we come to the eastern edge of the red sandstone, and the base of the first range of hills forming the eastern boundary of the Connecticut Valley. These hills of metamorphic rock reach about six hundred feet in height. Crossing the range to the eastward, we descend into the valley in which the village of Monson is situated. The quarry is located on a low foot-hill at the eastern base of this first range. It extends from near the crest of the hill, over quite an area upon its southern end and western side, and where the surface is only gently inclined.

The rock at the quarry is chiefly gneiss. It is of fine, even-grained texture, quite free from impurities, and valuable for architectural purposes. The strike is north 10° east,[2] and the dip is west 10° north, at an angle of 80°. The rock is not divided by planes of stratification, but a set of parallel joints, cutting transversely to the stratification, divides it into regular beds, that at a distance, might be mistaken for strata. These beds incline only about 10° from a horizontal position, and are nearly parallel to the general surface of the hill. They vary in thickness from a few inches to several feet.

In quarrying, the beds are first broken at the lower or western side of the quarry. The stone is then obtained by first drilling small holes in rows, parallel to the strike of the stratification, and upon the upper surface, of the beds. Into these holes wedges are driven,

[1] Since this paper was read, it has been so enlarged as to include the observations made up to the time of publication.

[2] Magnetic.

thus breaking the rock into slabs of regular form. The beds are so free from seams, and the rock is so homogeneous in structure, that pieces of great length may be obtained in this manner. In working from the lower side of the quarry towards the upper, the edges of those portions of the beds which are still in position, rise above each other like successive steps. The edges of these steps form nearly straight lines, parallel to the strike of the strata. When these portions of the beds remain sometime without being worked, cracks frequently appear along these edges. If still allowed to remain undisturbed, the fractures become more extensive, and frequently break up large quantities of the excellent stock of the bed. It has been found by experience that when these cracks first appear their extension may be prevented, and the stock preserved from further injury, by making an opening in the bed, trending in easterly and westerly directions, thus cutting it across the strike, and at right angles to the ordinary working lines. It is evident that such an east and west opening could counteract only a force which is exerted in nearly north and south directions. That the force works in the direction of the strike of the strata, is still further evident upon the examination of some of these fissures. A single example may be sufficient for illustration.

When at the quarry, April 29th, 1871, I observed an irregular fracture in a bed three feet and nine inches in thickness. The fracture was about sixty-one feet long. The northern portion of thirty-eight feet was nearly parallel to the strike, and the southern part of twenty-three feet curved to the eastward, and was accompanied by secondary fractures near it. Commencing at the northern end of the fracture and going southward, it would be noticed that at a few places it turned suddenly to the east, and immediately to the south again, thus making two right angles in its course. At these places the very short portions of the fracture trending eastward were wider than the long ones running southward, thus showing that the greatest movement had been from the north towards the south. At that time, April 29th, the southward movement had amounted to three-sixteenths of an inch; but when I visited the quarry July 7th, it had amounted to five-eighths of an inch, though at the time, the greatest width of the crack, at any place where it followed its general north and south course, was only one-fourth of an inch. Therefore the force which fractured the rock, had moved the relieved portion southward, more by three-eighths of an inch than it had been moved westward.

Spontaneous fractures, similar to the one described above, have been visible at the quarry whenever I have visited it. Sometimes they are quite large. I measured one, July 7th, which was full four inches wide.

Another series of phenomena is exhibited at the quarry, in the spontaneous elevation of the beds and the formation of miniature anticlinals. These elevations are common, and affect beds differing in thickness. In April I observed two anticlinals which had been recently formed. In one instance, a bed one foot eight inches thick had been elevated one inch and a half. The curvature of the upper surface of this bed was most distinctly visible. From the crest of this anticlinal to the base of the northern slope, the distance was twenty-three feet. The base of the southern slope could not be determined on account of the *debris* which had accumulated there. At one end of the crest there was a crack three-sixteenths of an inch wide, trending with the fold nearly east and west, but at the other end no fracture could be seen. In the other instance the bed was three inches thick, and at the centre had been elevated one inch. A fracture extended the entire length of the crest, which trended nearly east and west, as in the preceding instance.

On the afternoon of July 7th, a little anticlinal was formed while I was at the quarry. The bed was only two inches and three-fourths in thickness. The span of the arch from north to south was five feet five inches and a half. The length of the crest was five feet and a half, and a fracture extended the entire length of it. During the afternoon, the portion of the bed forming the crest was elevated three inches and a quarter. The situation showed that the force which caused the elevation, was not an artificial one used in working the quarry.

According to the testimony of the persons occupied at the quarry, explosions sometimes attend the fracturing and elevation of the beds. Mr. A. T. Wing, superintendent at the yard, says that cracking sounds are very frequently heard, especially after the work of the day, and the noise attending it has ceased. Though these sounds are more frequent in warm weather, yet they are heard in winter. These explosions sometimes throw dust into the air, and he has seen stones, weighing a few pounds, thrown several feet high by them. The sound of these explosions is sometimes as loud as the blasting of rock, and in a few instances it has been even louder. At one time, after the workmen had left the quarry, so loud a report was

heard that they supposed the powder magazine had exploded. On hastening to the spot they found that it was not the powder, but the rock, which had exploded. A portion of a bed of nearly circular outline, and more than thirty feet in diameter and one foot in thickness, had been thrown up and broken. When they reached it, a portion at the centre was three feet above the surface from which it was broken, and the rock was still cracking and falling.

Another very interesting phenomenon is the expansion of the rock, as it is being quarried.

The most remarkable instance of this was observed in the autumn of 1869. By the use of more than twelve hundred wedges, a bed was split three hundred and fifty-four feet in length, in a line along the strike of the rock. The fracture extended from the northern and upper portion of the quarry southward, for the distance mentioned, but could be traced no further; so that this slab, which for three hundred and fifty-four feet had been fractured from the rock, was at its lower end, still attached to the bed, apparently as firmly as ever. The stone thus partly loosened, was eleven feet wide and three feet thick. At the upper portion of the fracture it was soon noticed, that the halves of the drill holes upon the freshly broken edge of the slab were not directly opposite their corresponding halves on the edge of the parent rock, but that they had been moved further up the hill, toward the north. At the extreme lower end, the wedges were still firmly held in the rock, and there was no perceptible evidence of any movement. But in passing from the lower end to the upper, the first evidence of expansion was shown in only a slightly oblique position of the corresponding halves of the drill holes. Passing on, the amount of unconformability of position increased regularly, until at the upper end it amounted to an inch and a half. Thus from the lowest wedge to the upper end, the stone was an inch and a half longer than that portion of the bed from which it had been broken. There is an abundance of testimony to this instance of expansion from those engaged at the quarry, and from those who came to the locality to see the curiosity. The stone was allowed to remain in the position above described for more than two months, and during that time it was exposed to warm and cold, and to wet and dry weather; but these changes of temperature and moisture produced no perceptible difference in the amount of the expansion. As the expansion was from the lower end to the upper, gravity could not have been a cause of the phenomenon.

In three instances, I have had the opportunity of observing the rock, when it has been split at shorter lengths in the manner described above. In each case the expansion was sufficient to admit of measurement.

Near the upper end of the quarry, four hundred holes had been drilled into a bed, making a row one hundred and twenty-eight feet long. When the wedges had been driven sufficiently to merely fracture the rock, and while most of them were still firmly held, the expansion amounted to one-sixteenth of an inch. The stone which had so expanded, was eleven feet wide, and three feet thick at the lower end, and five feet thick at the upper. In this example the upper end was the one attached, and the extension was southward.

Near the southern end of the quarry, a split thirty-three feet and a half long had been made. Here the slab was firmly attached to the bed at the lower end. Its width was six feet and nine inches, and its thickness one foot and eight inches. I was permitted to take out the wedges, when I found the expansion amounted to one eighth of inch at the upper end. I could distinctly see that it increased regularly in amount, from the lower end to the upper.

The other instance was in the working of a bed, the western edge of which extended in a direct line along the strike, without having been anywhere cut or fractured transversely. A row of wedges fifty-eight feet long was driven into holes upon the upper surface of the bed, and seven feet from its edge, thereby splitting the bed only along the line of the wedges. It was then necessary to cut from the western edge of the bed eastward to this fracture. The workmen attempted to do this by taking out a piece in the form of a triangle, the base of which was upon the edge of the bed, and the apex reached the upper end of the fracture. They found this a somewhat difficult task. The piece appeared to be held by something more than the tenacity of the rock, and it was necessary to break it into small pieces before it could be removed. When considerable stone had been cut away, cracking sounds were heard, and the remaining portion of the triangular mass was quickly fractured and easily removed. For two hours I had been watching the corresponding halves of the drill holes, at the upper end of the fracture first made by the wedges, to observe at what period of the work, the expansion, if any, should take place. The halves of the holes remained perfectly conformable in position, up to the time of the cracking sounds and the loosening of the stone, but immediately upon this taking place,

those upon the edge of the slab were one-fourth of an inch further to the north, than those of the parent rock.

Prof. Johnston, of Middletown, Ct., has described[1] "*some spontaneous movements occasionally observed in the sandstone strata in one of the quarries at Portland, Ct.*" The movements there observed, he says, are the sliding of one stratum upon another. These occur whenever a stratum at the bottom of the quarry is first broken by excavating a channel in it, which trends in easterly and westerly directions. When such a channel has been cut only partly through the thickness of the stratum, the stone remaining at the bottom is crushed with a loud report, and the edge of the northern side moves southward about three-fourths of an inch. "These facts," he thinks, "plainly show that the strata of sandstone at this place are not, at the present time, perfectly at ease in their ancient bed," but he does not attempt to determine the cause.

I am not aware that any other scientific man has observed and recorded facts similar to those given by Prof. Johnston. Probably such phenomena are to be observed at comparatively few localities. At many quarries the rock is so divided by loose joints, that it would quietly yield to a force, which at Monson would cause the phenomena described. From some statements made to me by persons interested in quarrying extensive and comparatively unbroken strata, I am inclined to believe that facts of a similar character might be collected.

When I visited Portland, the condition of the quarries gave me no opportunity for observing phenomena of the kind described by Prof. Johnston. I found, however, that the facts were well known to those who had been engaged there for a long time, through whom I was able to determine that the movements were from east of north towards west of south, or very nearly parallel to the directions of the movements at Monson. The force causing the phenomena at the two localities may be identical, for the manner of working the quarries at Portland gives no opportunity for observing fractures, elevations and expansions, like those so well shown at Monson.

Certain features in the structure of rocks, as cleavage, for example, have been considered, by eminent geologists, as evidences of severe compression; also, polished and striated surfaces have been regarded

[1] Proc. Am. Association for the Advancement of Science. Eighth Meeting. 1854. p. 283.
National Magazine. Vol. III, No. 4. Oct., 1853. p. 362.

as proof of a sliding and slipping of parts. These features, however, afford no evidence of present action.

The phenomena observed seem to me to establish the following facts concerning the rocks at Monson: —

1. That they are compressed at the present time with great force.

2. That there is a lateral pressure exerted in northerly and southerly directions, but no indications of any acting in an easterly and westerly course.

3. That beds of very compact rock may be flexed and broken by lateral pressure, as seen in the actual formation of anticlinals.

4. That continued pressure does occasionally culminate in explosions and movements of the rock.

5. That even compact gneiss is, to a certain extent, compressible and elastic.

6. That whether lateral pressure originally brought the rock to its present compressed state or not, it now keeps it in that condition, excepting, of course, where it has been artificially removed; then the rock expands.

I believe that these and similar phenomena, will throw important light upon the more extensive folding, fracturing, and movement of rocks, and the elevation of mountains; but the discussion of these important relations is reserved with the hope of illustrating them by further observations, in a future paper.

Dr. C. T. Jackson and Rev. J. B. Perry mentioned instances of similar expansion of solid rock masses which they ascribed to changes of temperature.

Dr. P. P. Carpenter, of McGill College, Montreal, made a communication on the family of Chitons.

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## January 18, 1871.

The President in the chair. Forty-four persons present.

The following paper was presented :—

### Experiment with the Poison of the Cobra de Capello of India (*Naja tripudians*). By George Sceva.

Jan. 8, 1871. One quarter of a grain of the dried poison, which had been kept a little more than seven months, was dissolved in

twenty drops of water, and the liquid reduced by evaporation at a temperature of 85° Fahr. to four drops. This was exposed to the air at a temperature of 22° and completely frozen in four minutes (the warmth of the porcelain vessel retarding the process slightly). The poison was allowed to remain in the frozen state sixteen hours, during which time the temperature fell to 8°—or 24° below the freezing point. On the following day, Jan. 9th, the poison was thawed and diluted with three or four drops of water, and two drops of the liquid injected with a fine pointed syringe into the pectoral muscle of a pigeon about half an inch from the keel of the sternum, the point of the syringe penetrating the muscle about one-eighth of an inch. This part of the pigeon's body was selected in order to avoid wounding any of the viscera or large blood vessels. The poison was injected at 4.32′ P.M.

4.34′. A motion of the bowels. Although this almost invariably occurs as the first symptom of the action of the poison in the lower animals, it cannot be fully relied on in the case of birds, as it very frequently occurs from fright.

5.10′. Another motion of the bowels, followed by slight tremors and convulsive movements clearly indicating the action of the poison. Dr. Thomas Dwight, Jr., who was present, thought he observed in the general appearance of the bird the action of the poison a few minutes earlier.

At 5.15′, no further symptoms were shown. At this time I left the room for about two hours and on returning a few minutes past seven found the pigeon dead, its death having occurred in less than two and a half hours from the time of being poisoned.

Since making this experiment I have found that a similar one has been made on the venom of the rattlesnake by Dr. S. Weir Mitchell, of Philadelphia. Dr. Mitchell found that neither boiling nor a putrefactive change destroyed its poisonous action. These experiments have also been made with the venom of the Cobra de Capello with like results.

Mr. Sceva, after reading the report of his experiment, made some general remarks on the habits of the cobra and on the action of its poison. He said he had been much surprised, on looking over some of the works on natural history, at the erroneous statements which some of them contain respecting this subject. He thought these errors might be attributed in a great measure to the general dread and aversion which people feel for all poisonous reptiles. This

seemed to account, when combined with the usual credulity shown in such matters, for the many strange stories and absurd reports that had been published concerning the poisonous snakes of distant countries, such as India; and in many instances he had found that men holding high positions in the government civil service, and physicians residing in that country, had published statements which had been accepted here and in Europe as facts—well established by their personal observations and careful investigations,—whereas they were founded merely on the stories told by the jugglers, snake-charmers, and other ignorant people. In some popular works on natural history recently published, which on many subjects appeared to be carefully written, there seemed in this matter a great want of careful discrimination. In J. G. Wood's natural history of reptiles, several pages were devoted to accounts of antidotes, such as the leaves and root of the *Aristolochia Indica*, the "snake-stone," etc. These, with a great many other reputed antidotes had been found by recent investigations to be utterly worthless.

Mr. Sceva during the past three years, while attached to the Indian Museum at Calcutta, had assisted Dr. Fayrer, (the Professor of Surgery in the Medical College there) in his numerous experiments with the venom of poisonous snakes. Among those made to test the value of local applications, was that of the use of the actual cautery by plunging pointed red-hot irons deeply into the flesh in the places where the fangs had entered, but this failed to destroy the poison. This result, however, would not surprise one who fully understood the rapidity with which the blood passes through the soft tissues of the body and the instantaneous action of the poison upon it.

To show the rapid effect of the poison on the blood, Mr. S. read one of Dr. Fayrer's experiments that he had witnessed, in which the inguinal fold of the skin of a dog was held by two pairs of long-bladed forceps in such manner as to include a triangular piece of about three inches on a side. The cobra's fangs were applied to the middle of the free edge and with a sharp scalpel held in readiness the piece of the fold of the skin was at once cut out, and yet the dog died from the effects of the poison in fifty-nine minutes. Dr. Fayrer in his report made the following comments.

"This was a very interesting and instructive experiment, most clearly demonstrating the deadly nature of the virus and the awful rapidity with which it passes into the circulation. The bitten part was not merely excised as we speak of excising the parts around the

spot which the fang had penetrated, but the fold of skin into which the fangs had injected the poison was removed within a second after the bite, for the knife had entered almost before the fangs had left. In fact it could not have been done more rapidly, and yet within one hour the animal was dead from the effects of the poison. The infinitesimal portion of time during which the cobra's fangs were inserted into the tissues was sufficient to have sent the poison through the circulation beyond the reach of incision; and yet how very small must that quantity have been."

Mr. Sceva exhibited on the president's table a living specimen of the cobra which he had brought with him from India. It was about five feet in length and of the variety known in India as the "Keuteah." It had eaten nothing while it had been in his possession, since the 8th of June last, a period of seven months and ten days.

He had also kept others in India for over five months without food.

He said that the common belief that the cobra would seek to exercise its deadly power by biting any person who should come within its reach was quite erroneous; on the contrary it avoided using its fangs as much as possible except when securing its food. When two cobras were placed together in a cage, they would sometimes strike at each other for hours with their noses, and would blow their venom and saliva from their mouths, but he had never seen one bite another, although he had kept a large number of them in cages convenient for observation.

Of the great number of deaths (some thousands) occurring annually in India from cobras, the bites were almost always received when people stepped upon them.

Until very recently it was almost universally supposed that the poison of the cobra had no effect on the mongoose, an animal resembling the weasel. It was well known that the mongoose would attack and kill the cobra and would sometimes eat a large part of the body; but in these encounters the mongoose by his great agility could easily avoid being bitten, and Mr. S. had found on examining a cobra after being killed by a mongoose that all the wounds had been inflicted back of the head. When, however, the mongoose was secured and a cobra was compelled to bite its leg by having it put into the snake's mouth, the mongoose died in a very short time.

Dr. Charles Pickering made a verbal communication on the "drift" and especially the examples of it, which he had carefully studied in Salem. These he explained by diagrams on the blackboard.

He said Prof. Agassiz's idea of a great mass of overlying ice seemed at first to account for the movement of the boulders near Salem, but there are circumstances that hardly correspond. Once enveloped in ice, fragments of rock, whether large or small, would be all treated alike, whereas the largest of the Salem boulders are pretty regularly left near their source; water, as suggested by Dr. Jackson, would make this discrimination, but there is more resemblance to the probable effect of a slight check of the earth's rotation, sending loose material eastward.

The source of supply is clearly defined, a bed of syenite extending along the west side of Tapley's brook from Danvers to Saugus; the derived boulders are scattered over a bed of greenstone-trap, from Tapley's brook eastward to the sea; and the exact amount of force expended in transporting each boulder to its present position can be mathematically demonstrated.

Neither beyond nor around Salem had he ever met with a fragment of conglomerate, even in the finer "drift." Eight miles farther south, on the edge of Little Nahant, he had found a large boulder of porphyry-conglomerate, that came, in all probability, from the hills between East Boston and the sea, and therefore nearly due east.

These boulders having been transported by some cause that has ceased to operate, a question arises as to the date. Was it anterior to the advent of the existing species of animals and plants on the surface of the earth?

Mr. Hyatt stated that he had recently explored the region referred to by Dr. Pickering, and could confirm the statements of that gentleman, so far as they related to the limited distribution of boulders. The geology of that vicinity was of great interest, and had been the object of several of his excursions during the past summer. He then described the valley which leads southward from Peabody to Swampscott, as having been at one time filled by a vast body of eruptive syenite. Remnants of this are still to be found capping the summits or forming the south-western face of the ridge on the eastern side, while on the western side they project in numerous,

round-topped hills, which continue until they abut against, or change into, the flesh-colored syenite that lies in contact with the Lynn porphyries. To the east of this a great thickness of a very remarkable granitic rock had been observed, which presents in various localities a gneissic structure with perceptible strike generally to the east of north, which had led him to think it the broken and much altered remains of a sedimentary rock. Salem township, Swampscott and part of Peabody are underlaid by this formation. The whole mass to an unknown depth has been uplifted and shattered by internal forces, which at the same time have injected the cracks and crevices with fleshy or white feldspar, more or less homogeneous or mixed with quartz, and in some instances mica or horneblende, according to the locality.

The cliffs along the Marblehead shore admirably illustrate this point. One large cliff especially, near the line between Marblehead and Swampscott, would make a solid mass if all the injected rock were removed from the seams.

Richard Bliss, Jr., called attention to some of the peculiar markings which distinguish the young from adult fishes. In examining some specimens recently received at the Museum of Comparative Zoology, from India, which had a double band on the side of the body, or rather a single line starting from the gill-covers, running to the tail and then returning to the gill-covers, he found this to be the young state, and this the manner in which a dark, solid band was formed, and became perfect as the fish reached the adult state. Another species forms a band which entirely disappears leaving only a spot at the head and another at the tail. A third species begins with a band, which is at length resolved into cross bands. These examples, he said, show the necessity of studying fishes in all stages of their growth.

Capt. N. E. Atwood made a few remarks on the habits of the Blue-fish, *Temnodon saltator* Cuv. It was not found north of Cape Cod until the year 1847. Since that time it has been abundant in Eastern waters, appearing annually about the fifth of June, but in his opinion is now gradually disappearing. He also referred to other species, viz.: the

Weak-fish, *Otolithus regalis* Cuv., the Spanish mackerel, *Scomber Decayi* Storer, and the Halibut, *Hippoglossus vulgaris* Cuv., as gradually occupying the waters of a higher latitude.

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## February 1, 1871.

The President in the chair. Forty persons present.

The following papers were presented:—

### Notices of some Heteroptera in the Collection of Dr. T. W. Harris. By P. R. Uhler.

#### Fam. PACHYCORIDA.

##### Aulacostethus. Nov. Gen.

Head about two-thirds as long as the width across the eyes, much shorter than the pronotum; bluntly curving to the tylus. Tylus longer than the lateral lobes, cylindrically elevated above the plane of the adjoining surface. Ocelli near the base and not far from the eyes. Inferior lobes blunt, convexly thick, the bucculæ very slender; rostrum extending almost to the end of the second ventral segment; the second joint subequal to the third and fourth united; the third and fourth equal. Pronotum almost twice as broad as long, subhexagonal, the lateral and posterior angles bluntly rounded; the anterior aspect steeply convex, the humeri elevated into a rounded knob, bounded inwardly by a distinct depression; the lateral edge narrow, raised, the submargin longitudinally impressed. Sternal raised flaps short, broadly rounded, not quite reaching to the base of the antennæ. Lateral margin of the sternal groove feebly elevated between the anterior and intermediate coxæ, but thick and much elevated between the intermediate and posterior coxæ. Femora stout; exterior face of tibiæ obsoletely carinate, the exterior edges acutely carinate. Odoriferous duct long, rather straight, running from the coxa almost to the exterior margin of the plate on which it lies, the osteole placed at the inner end of the groove, the groove deep and occupying more than one half the length of the duct. Scutellum a little humped at base, a little inclining from the base to the middle and then obliquely declining to the tip; the sides broadly rounding towards the tip; edge of connexivum acute.

**A. marmoratus.**

*Tetyra marmorata* Say. Heteroptera, New Harmony. p. 2, no. 1.

No. 112. Harris Collection. "North Carolina, April. Mr. Nuttall."

Mr. Say's specimens were obtained in New Jersey. A male from Maryland, in my own collection, is much smaller than the specimen of Dr. Harris; but it agrees, in all other respects, with his type. The description of Mr. Say is too short to limit the species precisely, but it is likely that the present type was determined, as were many others, by Mr. Say himself.

## Fam. STIRETRIDA.

### PODISUS Stål.

**P. serieventris**, n. sp.

Similar to *P. modestus* Dallas, but of a more blackish grey color. Pronotum, sides less deeply sinuated, the humeral angles not so prominent, obtusely triangular, blackish; the surface less regularly punctured, those each side anteriorly and in the corners finer, confluent, presenting the appearance of four blackish spots, the middle surface somewhat bald, yellow. Scapus and basal joint of the antennæ blackish outwardly. Scutellum punctured with black, the punctures at base aggregated in a large patch, the basal angles with a large, smooth, whitish spot, the tip smooth, white. Pectus remotely punctured with fuscous, the impressed portion of the propleura, the middle of the mesopleura, and exterior part of the metapleura with a large patch of black, confluent punctures, the exterior margin smooth; exterior end of the osteolar duct black, the sulcus broad, not reaching to the tip. Legs pale orange-yellow, the femora pointed with black, the dots more or less aggregated beyond the middle. Corium less coarsely punctured, the punctures fuscous or rufous; those of the costal area coarser, the finer ones aggregated in small patches; the surface adjoining the inner surface and tip of the median suture smooth, with a more or less embrowned spot before the tip; embolium yellow, with a fuscous spot at base; the membrane tinged with brown, the basal margin, nervures basally, and a broad, longitudinal streak running to tip blackish. Tergum with large clouded spots each side and behind; connexivum bright yellow above, with a quadrangular black spot at the base and apex of each segment, on the under side having

a corresponding series of spots which are sometimes reduced to mere dots. Venter punctured with rufous and black, the latter arranged each side in a longitudinal series of patches; interior to these is a row of black spots, and upon the middle line four round spots, with the largest one at the posterior end.

Length to tip of abdomen, 9½ millims. Humeral width, 5 millims.

No. 40. Harris Collection. ♂. "Cambridge, Mass., April 20th, 1827."

The specimens vary very much in depth of color and in the size and distinctness of the markings.

In my own collection are specimens from Maine and Minnesota. A female from Massachusetts is twelve millims. in length.

## Fam. HALYDIDA.

### Brochymena Am. et Serv.

**B. Harrisii**, n. sp.

Similar to *B. annulata* Fab., but broader and shorter. Head elongate-subquadrate, much shorter than in *B. annulata*, the lateral margins straight, parallel; the tylus a little shorter than the lateral lobes, the anterior prolongations of these lobes not much longer than the lateral projections, the exterior corner of the latter almost toothed. Pronotum short and broad, the anterior lobe having the lateral teeth direct and sub-equal in size; humeral angles obliquely rounded, elevated, having a few short, oblique, ill-defined teeth, the surface behind the humeri obliquely impressed. Connexivum with a transverse, black, subdepressed spot before and behind each incisure. Membrane, hardly reaching beyond the abdomen, charged with fuscous ramifications as in *B. annulata*. Venter very convex, the longitudinal groove continued distinctly to the penultimate segment. Femora mottled with brown, having a yellow, macular ring before the tip; tibiæ brownish, with a yellow ring upon the middle.

Length, 16½–18 millims. Humeral width, 9½ millims.

Hab. South Carolina. In Dr. Harris's Collection, without a number. A female in my own collection was taken in Lancaster Co., Pennsylvania, from a tree, in the month of May.

### Trichopepla Stal.

**T. semivittata.**

*Pentatoma semivittata* Say. Heteropt. p. 9, no. 21.
*P. semivittatum* H. Schf. Wanz. Ins., fig. 766.
*P. pilipes* Dallas, Brit. Mus. Catal. Hemipt., p. 247, no. 37.
*Trichopepla pilipes* Stål, Ofv. 1867. p. 528.
No. 89. Harris Collection. "North Carolina, Prof. Hentz."

## Fam. PENTATOMIDA.

### Euschistus Dallas.

**E. fissilis**, n. sp.

Form and general appearance of *E. servus* Say. Pale yellow, finely aciculatedly punctured with fuscous or black, the punctures more or less grouped together, and appearing very dense near the lateral margins of the pronotum. Head appearing split in front, caused by the prolongation of the lateral lobes beyond the tylus. Basal joint of antennæ not reaching to the tip of the head, the second joint a little shorter than the third. Surface of the pronotum depressed each side in front of the humeral angles, humeral angles prominent, rounded, alike in both sexes. Corium more or less, and membrane distinctly, dotted with fuscous. The whole inferior surface minutely sprinkled with red, the specks on the pectus larger; underside of the head and pectus coarsely punctured. Venter polished, finely punctured.

Length 12–13 millims. Humeral width 8–8½ millims.

No. 2. Harris Collection.

Dr. Harris refers this species to *E. punctipes* Say, making it synonymous with *E. serva* Say; but it differs from both in distinct characters which seem to be permanent.

### Neottiglossa Kirby.

**N. undata.**

*Pentatoma undata* Say. Heteropt. p. 18, no. 17.
*Neottiglossa trilineata* Kirby. Fauna Bor. Amer. p. 276, 3; pl. vi, fig. 6.
*Ælia trilineata* Dallas. Brit. Mus. Catal. Hemipt, p. 224, 6.
No. 83. Harris Collection. "Ipswich. Mr. Oakes."

The European congener of this species has been referred by Dr. Fieber to a new genus *Platysolen*, which he established for it. The generic name here adopted has priority over that of Dr. Fieber, and should be adopted in its stead.

LIODERMA. Nov. Gen.

General characters of *Pentatoma* Fieber. Body longer in proportion to its width than in that genus; pronotum, together with the head, forming a long triangle. Rostrum reaching at least to the middle of the first ventral segment, the first joint much shorter than the head; bucculæ not reaching quite to the base of the head, very slender, dilated at the anterior end. Antennæ as long as the corium, the tooth at base of scapus long. Scutellum long, rather narrow, fully two-thirds as long as the abdomen. Osteolar canal closed, subcylindrical, the orifice of the osteole opening beneath a projection at tip of the canal. Corium a little produced at the outer extremity.

1. **L. saucia.**

*Pentatoma saucia* Say. Heteropt. p. 6, no. 12.

No. 47. Harris Collection.

2. **L. senilis.**

*Pentatoma senilis* Say. Heteropt. p. 5, no. 8.

*Pentatoma grisea* Dallas. Brit. Mus. Cat. Hemipt. p. 246, 33.

No. 38. Harris Collection. ♂ ♀. "June 30th, 1826. May 10th, 1835."

ATOMOSIRA. Nov. Gen.

Oval, the sides subparallel, not dilated posteriorly. Head short, rounded in front, the sides sinuated before the eyes; eyes large, subtruncated behind. Antennæ longer than the head and thorax united. Rostrum reaching beyond the first ventral segment; bucculæ slender, waved, not reaching the base of the head. Thorax hexagonal, convex, transverse, the lateral margins thickened, almost straight, posterior margin concavely arcuated; mesosternum with a feeble carina which becomes enlarged and produced at its anterior end. Scutellum long, suddenly narrowed before the tip. Corium curved on the posterior margin, the exterior angle a little produced. Venter convex, the basal spine rudimentary. Osteole situated at the outer end of a short, closed duct, the groove running from it outwardly very slender and long.

**A. sordida**, n. sp.

Brownish, or greenish-yellow, polished, the upper surface punctured with fuscous or black. Face finely, closely punctured, each side of tylus, and some spots near the occiput and eyes impunctured; basal and second joints of antennæ green, the other joints reddish, excepting their greenish bases; rostrum green, paler at base, the apical joint piceous. Pronotum coarsely, deeply punctured in transverse, wavy, interrupted lines, the lateral submargins impressed, more densely and finely punctured, the lateral margins and some spots behind the head, and also upon the anterior margin, smooth, yellow; humeri rounded. Sides of the antepectus densely punctured near the anterior corners, the rest of the surface more coarsely, remotely punctured; medio and post-pectus each with a spot of dense black punctures upon the pleura. Legs green, the upper side of last tarsal joint and the apex of the nails piceous. Scutellum punctured in transverse, wavy, interrupted rows, the punctures finer towards the tip; tip yellow, impunctured. Corium guttated with distinct, deep punctures, which are more crowded near the base, the suture separating the exterior field of the corium piceous, and terminating upon the disk in an ill defined spot of the same color; membrane brownish, transparent, the nervures darker. Connexivum yellow, finely punctured, having a double black spot at the incisures of the segments, both above and below; venter remotely punctured with brown, the punctures more dense on the sides and near the base, each side with two longitudinal series of double, black spots.

Length 10 millims. Humeral breadth 5½ millims.

No. 71. Harris Collection. " August 30, 1828."

RHAPHIGASTER Lap.

**R. Pennsylvanicus.**

*Cimex Pennsylvanicus* DeGeer. Bd. III; p. 216; pl. XXXIV; fig. 5.

*Pentatoma abrupta* Say. Heteropt. p. 6, no. 10.

No. 129. Harris Collection. ♂. " Cambridge, Mass., Mr. Randall."

I have examined specimens of this species found in Panama, Illinois, New York, New Jersey and Mass.

Fam. MICTIDA.

METAPODIUS Westw.

1. **M. instabilis**, n. sp.

Blackish fuscous, sparingly clothed with yellowish pubescence; in

form less robust than *M. femoratus* Fab., and with the posterior femora much more slender and scarcely curved. Apical joint of antennæ bright orange, much longer than the others, the basal joint about equal to the second. Rostrum reaching the tip of the intermediate coxæ, hairy, more or less tinged with yellow. Pronotum a little broader than long, the humeri prominent, bluntly subacuminate, having a slightly backward curvature; the surface finely remotely punctured, and with small, scattered tubercles, some of which are excavated, the lateral margins deeply sinuated, the subcarinate edge bearing a few short, oblique, rather remote teeth, margins behind the humeri granulated. Scutellum transversely wrinkled, the extreme tip orange. Hemelytra minutely, closely punctured, the punctures becoming a little coarser upon the clavus, the costal area near its base bearing a few minute granules. Antepleura shining, granulated, punctured; the odoriferous glands fulvous. Legs blackish piceous; the tarsi and ends of the tibiæ fulvous, nails piceous; posterior femora almost straight, the teeth graduating in size towards the tip, the five in a row nearest the tip large and curved; posterior tibiæ dilated exteriorly through two-thirds of their length, sinuated on the middle, the base of the sinus almost acutely angulated, the opposite end tapering and beyond this a few small, remote teeth; the inner dilatation feeble, extending to about the middle, beyond this to the tip minutely tuberculate-denticulate, the upper and lower surface of the dilatation granulated.

Length, 19 millims. Humeral breadth, 7 millims.

No. 50. Harris Collection. ♂. *Anisoscelis prominulus* Say. Mss. Penn., Dr. Pickering; "North Carolina, Prof. Hentz."

**2. M. confraternus**, n. sp.

Dark brown, blackish fuscous beneath, clothed with yellowish, almost prostrate hairs, which extend also upon the legs.

Form and general appearance of the preceding species, but easily recognized by the long and very robust posterior femora. Antennæ slender, fuscous, the apical joint fulvous, longer than the basal joint. Pronotum minutely tuberculated, a few of the tubercles excavated, the humeral angles a little curved upwards, bluntly subacuminate; lateral margins subcarinate, armed with small, rather remote, tubercular teeth, the sides subsinuated. Antepleura polished, granulated, anteriorly with a few coarse punctures. Odoriferous glands orange. Scutellum a little elevated on the disk, each side with a shallow impression, surface transversely, obsoletely wrinkled, the extreme

tip orange. Hemelytra densely, finely punctured, minutely granulated at base and on the costal area. Legs blackish piceous, the anterior and intermediate from near the base, the tips of the posterior tibiæ and all the tarsi, fulvous; posterior femora robust, clavate, longer than in *femoratus* Fab., the row of five teeth nearest the tip large and stout; the tibiæ moderately dilated exteriorly almost to the tip, tapering, the sinuosity shallow, the angle at its base not very prominent, interior dilatation very narrow, sublinear, from its middle to the apex of the tibia minutely denticulated; three or four minute teeth on the opposite side of the tibiæ.

Length, 23 millims. Humeral breadth, 8 millims. ♂.

"Florida. Mr. Doubleday."

In Dr. Harris's Collection without a number.

## Fam. COREIDA.

### Neides Latus.

**N. decurvatus**, n. sp.

Form and general appearance of *Neides spinosus* Say. Luteus, or pale cinnamon yellow. Head with a slender, decurved tooth projecting forward and downward from the vertex. Thorax a little longer, less coarsely punctured, the callosities at the anterior end of the median carina small and indistinct; sternum dull black, no spines against the posterior coxæ. Tip of the corium of hemelytra without the dusky spot. Venter densely punctured.

Length 7–9 millims. Humeral breadth ¾–1 millim.

No. 72. Harris Collection. ♂ ♀. "Dublin, N. H., Mr. Leonard."

## Fam. LYGÆIDÆ.

### Ptochiomera Say.

**P. nodosa.**

*Ptochiomera nodosus* Say. Heteropt. p. 18, no. 9.

*Aphanus clavatus* Dallas. Brit. Mus. Cat. Hemipt. p. 560. no. 5.

No. 144. Harris Collection. "Alabama, February; Prof. Hentz."

This genus must not be confounded with *Plociomerus* Amyot and Serv., as has been done by several European hemipterists. The clavate, irregular antennæ and shape of the thoracic pieces are quite different from those of the types of that genus.

Following Dr. Erichson in Prof. Agassiz's Index Universalis, the above spelling should be changed to *Ptochomera*.

PLOCIOMERUS Amyot et Serv. (Autor).

**1. P. constrictus.**

*Pamera constricta* Say. Heteropt. p. 15, 1.

*Beosus abdominalis* Guerin. La Sagra. Hist. Nat. Ile de Cuba. p. 397.

No. 122. Harris Collection. "Milton, Aug. 15th, 1831."

This species extends from the West Indies to Canada.

**2. P. diffusus,** n. sp.

Closely allied to *P. silvestris* Linn. Dull black, minutely pubescent. Head black, very minutely punctured, above with minute, prostrate, yellowish pubescence, the face with a few long erect hairs; tip of the tylus piceous. Antennæ honey yellow, tinged with piceous, the apical joint and tip of third fuscous. Rostrum testaceous, more or less obscured, the apical joint piceous. Pronotum with remote, prostrate, white pubescence, and a few erect bristles; the anterior lobe dull black, smooth, very convex, much narrower than the posterior lobe; posterior lobe piceous, remotely punctured, the disk with three pale lines; humeral angles whitish, smooth. Pectus with remote, prostrate, whitish pubescence; a spot above each coxa, coxal tips, posterior edge of the metapleuræ, and legs, honey yellow; the middle of the anterior femora, an indistinct band near the tip of the posterior femora (and occasionally on the intermediate femora) and tips of all the tarsi piceous. Scutellum dull black, remotely punctured, clothed with remote, prostrate, whitish pubescence, the tip testaceous. Hemelytra honey yellow, more or less tinged with piceous, with whitish, prostrate pubescence, punctured in fuscous lines, with a larger blackish spot upon the lateral middle, almost touching the margin, and a smaller one at the exterior apical angle, near the interior apical angle with a small white spot; membrane brownish, the nervules and a spot at tip whitish. Tergum black, occasionally rufo-piceous on the disk; the venter dull black, or tinged with piceous, sericeous pubescent. Posterior margins of the ventral segments sometimes piceous.

Length, $5\frac{1}{2}$, $6\frac{1}{2}$ millims. Humeral breadth, $1\frac{1}{4}$, $1\frac{1}{2}$ millims.

No. 103. Harris Collection. "New Hampshire, Mr. Leonard."

Dr. Harris refers this species to *Pamera bilobata* Say, but it does not agree with Mr. Say's description.

### OZOPHORA. Nov. Gen.

Antennæ long and slender, the basal joint reaching fully one-half its length beyond the tylus. Eyes large, rather distant from the base of the head, prominent, but deeply inserted, the facets rather large, postorbital surface swollen. Pronotum campanulate, broader than long, at sides deeply sinuated, the anterior lobe rounded, convex, shorter than the posterior one, the sides bounded by a thick, raised margin; collum distinctly elevated, sinuated in the middle; posterior lobe very broad, the sides oblique, bounded by the continuation of the same elevated margin; humeri prominent, resembling long, thick tubercles. Impression between the lobes moderately deep. Disk of scutellum excavated.

**O. picturata,** n. sp.

Pale rufo-piceous, or rufo-testaceous, elongate-oval, colors beneath and upon the anterior lobe of pronotum opaque; hemelytra and base of pronotum glossy. Antennæ, rostrum, legs, hemelytra, posterior lobe of pronotum, and scutellum testaceous. Apex of the second and third joints and apical two-thirds of the last joint of the antennæ blackish; the basal third of the latter white. Head densely punctured on the middle line, front and near the eyes, beneath finely punctured; tips of the lateral lobes and of the tylus honey-yellow, apex of rostrum piceous. Anterior lobe of pronotum impunctured, brown, the raised collar yellow, with brown spots; lateral raised margins yellowish : posterior lobe coarsely, remotely punctured with brown, and usually with five longitudinal brown stripes; humeral angles smooth, yellow, generally with a brown spot exteriorly. Posterior and upper margins of the metastethium yellow. Scutellum remotely punctured, carrying a V-shaped, yellow line, the lateral edges and tip also yellow. Hemelytra punctured in oblique lines with brown, the clavus clouded with brown; corium with a small streak near the base, a broad spot behind the middle, reaching the outer margin by contact with a smaller spot, a spot at the apical exterior angle, continued along the membranal suture, fuscous; costal margin broadly white, impunctured; membrane fuscous, a few irregular lines near the base, the nervures and a large spot at tip white.

Length, about 6 millims. Humeral breadth, 1¼ millims.

No. 127. Harris Collection. ♀. "Cambridge, Mass., April 9, 1835."

### EREMOCORIS Fieb.

**E. ferus.**

*Pamera fera* Say. Heteropt. p. 16, 4.

*Rhyparochromus borealis* Dallas. Brit. Mus. Cat. p. 565, 16.

No. 73. Harris Collection. ♂ ♀.

The manuscript index to this collection gives the name *Anisoscelis prominulus* Say, Mss. to No. 73. The true genus *Anisoscelis* being known to both Dr. Harris and Mr. Say, the reference must have been originally made to an insect quite different from the one now bearing that number.

### PERITRECHUS Fieb.

**P. fraternus,** n. sp.

Elongate-oval, very slightly convex, black, dull. Head black, finely, remotely punctured both above and beneath, face pubescent, having some erect long hairs about the tip. Antennæ piceous-black, the scapus and incisures of joints pale. Rostrum and tip of tylus pale piceous, the former (♀) reaching beyond the mesosternum, the tip darker. Pronotum broad, the transverse impression very ill-defined, but more distinct at each end, lateral reflexed margin decurving anteriorly to meet the middle of the eyes; the surface dull, with remote, prostrate pubescence, the collar pale piceous; posterior lobe dull ochreous-yellow, with remote, coarse blackish punctures, humeri with a dusky spot in front. Pectus dull black, the pleural pieces remotely, obsoletely punctured. Legs pale rufo-piceous, the anterior femora blackish, excepting the knees; tibiæ dusky above, paler towards the tip; tarsi pale, but more or less dusky above and at tip: immediate and posterior femora dark piceous on the middle, the trochanters, coxæ and adjoining surface pale rufo-piceous. Hemelytra pale, dull ochreous-yellow, punctured with black in numerous oblique rows, a few dusky spots and clouds produced by aggregations of the punctures, the costal margin and two or more small spots on the disk smooth, yellow. Membrane whitish, with a spot near the interior angle, and a few less distinct ones on the middle and sides

brown. Venter black, polished, minutely, closely punctured, minutely pubescent. Tip of costal margin with a black spot.

Length, 5 millims. Humeral breadth, 1⅗ millims.

No. 146. Harris Collection. ♀. "Cambridge, Mass., April 20, 1837, under a board."

### Belonochilus. Nov. Gen.

Elongate, oval, flattened, pronotum and head together forming a long triangle. Head very long, acutely narrowing to the tip; the tylus narrow, projecting prominently forwards. Ocelli placed on a line with the back of the eyes and near them. Antennæ about half as long as the body, the apical joint subfusiform, much stouter than the others, about equaling the third in length; basal joint very short, not reaching to the tip of head, contracted at base, the second as long as the basal and third united. Bucculæ narrow, tapering to a point behind the middle of the throat, the rostral groove deep, narrowing behind. Rostrum slender, reaching behind the middle of the venter, the basal joint fully as long as the head, almost enclosed in the groove, second joint a little longer than the first, third about twice as long as the fourth, the fourth a little shorter than the first. Prosternal groove broad, not carried as far as the collum, mesosternal groove broad, well defined. Osteolar appendix auriculate, grooved. Base of venter triangularly produced against the sternum; the median line sulcate to behind the middle. Anterior femora very stout, armed with one large tooth. Membrane with five longitudinal nervures, and at base with one long and one transverse cell. Very closely related to *Orsillus* Dallas.

**B. numenius.**

*Lygæus numenius* Say. Heteropt. p. 15. 9.

No. 81. Harris Collection. ♀. "September 1st, 1829. Penn. Dr. Pickering."

A very rare insect in Maryland; but of which I have examined specimens from Ohio and Illinois.

## Fam. ARADIDÆ.

### Aradus Fab.

**A. robustus,** n. sp.

Fuscous, or rufo-fuscous, with close-set, short setæ over most of the surface. Form of *A. quadrilineatus* Say. Head broad, short,

deeply grooved each side, with the posterior part of the grooves more deeply sunken. Tylus narrow, high, rounded at tip; on the constriction behind it is a minute, elevated granule. Antenniferous processes stout, subacute at tip, extending almost to the tip of the basal joint of the antennæ. Antennæ very broad, a little flattened, the basal joint very short, not as long as the apical one; second joint longest, subfusiform, more than twice as long as the apical one, much stouter than the basal; third equally stout, a little more than one-half the length of the second, apical much narrower than the third, the tip subconical. Rostrum reaching fully to the anterior coxæ. Pronotum transversely elongate-oval, more than twice as wide as long, the lateral margins remotely denticulated, the teeth decreasing in size posteriorly; anterior margin subtruncated, posterior margin somewhat lobed behind the humeri; the disk with four longitudinal ridges, the lateral ones incomplete, curving inwards anteriorly, and on each humerus is a short ridge. Margins of the scutellum much elevated. Tibiæ pale yellowish, with the base, tip and a broad band on the middle, black. Disk of corium usually reticulated with pale ferruginous, which includes also the two elevated nervures; membrane pale, marmorated with fuscous, and having four long nervules. Middle line of venter incised; post-genital flaps long and broad, obliquely approaching at tip. Lateral margins of the posterior segments broadly scalloped.

Length, 5½–7 millims. Humeral breadth, 2–2¼ millims.

No. 82. Harris Collection ♀. "May 20th, 1829."

## Aneurus Curtis.

**A. inconstans,** n. sp.

Ferruginous, or rufo-fuscous. When deeply colored displaying a large, whitish spot upon the middle of the corium. Antennæ stouter than in the allied species, the second joint a little longer than the basal one, the third almost as long, or at least two-thirds as long as the fourth. Spines of the antenniferous tubercles acute and a little curved. The other characters are those common to the allied species.

Length, 6½ millims. Humeral breadth, 2 millims.

No. 13. Harris Collection. ♀. "*Aradus sanguineus* Say. Mss., May 29th, 1822, Mass. On a fence."

The following scheme embraces all the species known to me.

A. Coarsely granulated species.

Antennæ, second joint stout, longer than the basal one; third joint about one-half as long as the fourth. 1. *A. lævis* Fab., Europe.

Antennæ, second joint stout, longer than the basal one; third joint almost as long as the fourth. 2. *A. inconstans*, n. sp. Mass.

Antennæ, very slender, second joint more slender at base, much longer than the basal one; third joint less than one-half as long as the fourth; fourth very long and slender. 3. *A. simplex*, n. sp. New England.

B. Minutely granulated, highly polished.

Antennæ, second and third joints subequal, neither longer than the basal one; the fourth longer than any two of the others conjoined. Antenniferous tubercles not denticulated. 4. *A. politus* Say. Florida and Cuba.

## Fam. ANTHOCORIDÆ.

### Lyctocoris Hahn.

**L. domesticus.**

*Cimex domesticus* Schill. Isis. 1834. p. 738.

*Anthocoris bicuspis* H. Schf. Nomencl. Ent. p. 60.

No. 143. Harris Collection. "Alabama, Feb. North Carolina. Prof. Hentz."

Widely distributed throughout North America, and probably a species imported from Europe.

### Triphleps Fieb.

**T. insidiosus.**

*Reduvius insidiosus* Say. Heteropt. p. 32. 5.

*Anthocoris pseudo-chinche* Fitch. Second Report, p. 295.

The specimens in this collection are destitute of a number, and have no indication of the place where they were found.

## Fam. REDUVIDÆ.

### Pygolampis Germar.

**P. pectoralis.**

*Reduvius pectoralis* Say. Ins. of Louisiana, p. 11.

*Pygolampis fuscipennis* Stål. Ofv. Vetens. 1859. p. 380. 4.
No. 33. Harris Collection. ♂. "May 15th, 1826."

## Fam. EMESIDÆ.

### Emesa Fab.

**E. longipes.**

*Cimex longipes* DeGeer. Mem. III, pl. xxxv, figs. 17 and 19.
*Ploiaria brevipennis* Say. Amer. Ent. III, pl. xlvii.
*Emesa pia* Amyot & Serv. Hem., p. 394. 2.
*Emesa filum* G. R. Gray. Cuvier's Animal Kingdom, vol. II., p. 244, pl. xcvii, fig. 3.
*Emesa pia* H. Schf. Wanz. Ins. IX, p. 114, fig. 937.
No. 93. Harris Collection. ♀. "Penn., Dr. Pickering."

After carefully comparing specimens of this species, from many parts of the United States, with the descriptions and figures above cited, I feel convinced that they are all to be referred to that described by DeGeer. Dr Dohrn, Linnæa Entomologica, vol. XIV, p. 220, cites a species from Georgia for the *Ploi. brevipennis* Say, but Say's species came from Pennsylvania and does not agree with the description of Dr. Dohrn. It seems to me to be a new species which I have never seen.

### Plœaria Amyot and Serv.

**P. errabunda.**

*Ploiaria errabunda* Say. Heteropt. p. 34. 2.
*Ploiaria maculata* Hald. Proc. Acad. Phila. III, p. 151.
No. 107. Harris Collection. "New Hampshire, Mr. Leonard."

A somewhat immature specimen now remains in the collection. It seems to be rare, although widely distributed in the United States.

## Fam. HYDROESSÆ.

### Rhagovelia Mayr.

**R. obesa,** n. sp.

Allied o *R. collaris* Mayr, but differs in the colors, in the more contracted abdomen (unwinged) with its acutely produced tips of the connexivum, and in the absence of the tuft of hairs at the

end of the abdomen in the corresponding sex. Brownish, or bronzed black, the underside bluish sericeous. Head velvety black, the front almost truncated, cinereous, with an impressed longitudinal line running almost to base, with a few long hairs about the sides and above; base of cranium a little carinately elevated. Labrum and lateral lobes yellowish, or rufo-piceous; rostrum black, reaching to the tip of the anterior coxæ. Eyes brown. Antennæ, excepting the pale base of basal joint, black, basal joint stoutest, curved, about twice as long as the second, the second subequal to the third, the fourth decidedly shorter than the third. Thorax obese, pronotum velvety black, sparingly clothed about the sides with fine golden pubescence; the collum orange, interrupted in the middle by blackish, middle line, faintly carinated; tip of pronotum produced, at tip curved upwards, the extreme end expanded, with a granulated process at each corner (winged); in the unwinged, the posterior margin forms a long triangle with the angles bluntly rounded. Each side of prosternum broadly orange. Coxæ, trochanters and usually the base of femora yellow; the femora bronzed- or blue-black. Cerci of the male long, slender, curved, hairy.

Length, 3½–4 millims. Greatest breadth of pronotum, 1¾ millims.

No. 64. Harris Collection. "*Velia collaris* Say, Mss. On water, September 30th."

Occurs both with and without wings in some localities. Near Baltimore and in Eastern Massachusetts I have found great numbers of specimens, but always unwinged.

## Fam. HYDROMETRIDÆ.

### Metrobates. Nov. Gen.

Similar to *Halobates* Esch. (autor.) Robust and broad. Antennæ stout, almost as long as the entire body, the basal joint nearly as long as the three others united, curved at base, narrowing in that direction, much stouter in the male and expanded at the tip, the underside with erect hairs; second joint about one-third the length of the basal, greatly enlarged at tip, the third shortest, also enlarged at tip, fourth very stout, fusiform, almost as long as the second. Pronotum ample (in the unwinged form narrow and short, the mesothorax forming the stoutest and largest part of the body), a very little

wider than long, the posterior lobe large, and extending back in the form of a broad triangle with the sides nearly straight and the tip a little rounded; the lateral margins, including the humeri, forming high, broad ridges. Anterior legs stout, the tibiæ a little curved at tip, with the process small and almost in continuous contact with the surface on which it stands; the basal joint of tarsi about one-fourth the length of the second, the second having the unguicule placed about one-third from the tip. Intermediate femora about two-thirds the length of the posterior, the tibia not quite as long as the posterior femur and tibia conjoined; the tarsus equal in length to the posterior tibia and tarsus conjoined. Corium of hemelytra short, with two elongated cells occupying nearly the whole width; membrane more than twice as long as the corium, the looped nervule running parallel to the entire margin.

**M. hesperius**, n. sp.

Opaque, velvety blue- or brown-black, densely pubescent. Head robust, convex, brown, at base and each side of it rufous or orange, minutely, densely pubescent, the face blackish. Rostrum black, beneath shining, above densely greyish pubescent, at base more or less orange. Antennæ black, pubescent, the basal one-fourth of the basal joint orange. Pronotum very small in the unwinged specimens, and less than one-half as long as wide, having the anterior margin a little concave, the surface finely, closely pubescent, the middle line broadly depressed, yellow, invaded by gray or whitish lead color, which expands in running back and covers the whole width of the tergum to its tip, omitting only a few black streaks on the disks and margins of the segments. The whole pectus, venter and two spots on the pleura lead color with a sericeous gloss.

The winged form has the pronotum blackish-brown, densely pubescent, the middle of the anterior lobe broadly depressed, covered by an orange spot, but lacking the bluish stripe. Coxæ yellow beneath, legs brownish-black, the anterior pair yellow at base, the yellow color continued further on the under side. Sternum blackish, each side of it yellowish. Hemelytra dark brown, with a faint, paler streak on the median suture, at base and on the costal margin pubescent. Venter cinereous, the disk of the penultimate and base of the last segment yellow.

Length to tip of hemelytra 5 millims. Extreme width of mesothorax 2 millims. Unwinged, length, 3–4 millims. Mesothoracic width $1\frac{3}{4}$ $2\frac{1}{4}$ millims.

No. 29. Harris Collection.

## On the Causes which have led to the Production of Cape Hatteras. By Prof. N. S. Shaler.

It is an almost self-evident proposition that the geological structure of a coast line is the key to its character; that the subterranean features have determined its outward contours. It is equally clear that the changes now going on along any coast must depend to a great extent upon the geological character of the materials along that coast. These considerations make it seem necessary to study the geological disposition of the materials along any shore, as the condition on which we may hope to attain to a true understanding of the causes which have determined its form. In endeavoring to arrange a plan for the examination of the geological history of the shore line of the United States, it is at once obvious that the first thing to be done is to interpret the history of the most conspicuous features of the shore, in order to obtain the basis for the detail work. Inspection of the map of the eastern coast of North America shows the existence of a number of great indentations and projections. It is obvious that these must depend upon some great geological facts which require interpretation. I propose to discuss here the causes which have led to the production of one of the most important irregularities, the great salient angle of our southern shore known as Cape Hatteras. The geological facts already in our possession have failed to account for the existence of this projection. The general character of the shore at that point, and of the low lands which lie between the sea and the base of the Alleghany mountains, is such as to make it seem at first sight unlikely that the shoulder which the continent forms at this point is to be referred to disturbances of the underlying rocks. The region, for nearly one hundred miles to the west of Cape Hatteras, is nearly level, and seems to be a northward prolongation of the great southern plain which extends from Texas to Virginia; a singularly monotonous surface, with little indication of disturbance away from the immediate contact with the borders of the Alleghany chain. Along the whole stretch of coast from near the mouth of the Rio Grande we find the shore line everywhere bordered by this plain, and throughout its whole extent presenting no features which require us to call in the aid of geological dislocations to explain, saving the projections at the mouth of the Mississippi and the peninsula of Florida. The shore, from Matagorda Bay to near Hatteras, forms an almost uniformly curved line. The consider-

able salients at these points are easily accounted for; the first is obviously the product of the Mississippi, and the second the result of the action of the reef-building corals (as has been shown by the researches of Agassiz and others), aided, it may be, by the action of the mud of the Mississippi. It is evident that this projection at Cape Hatteras is due to neither of the causes which have produced these more southern reliefs. It is not like the Louisiana salient, the product of the detritus deposited at a river's mouth, for the rivers emptying at this point are small and carry but little amount of detritus; besides, it will be evident from the details of the geological structure of this region, that the shore is waning at the mouths of the rivers rather than gaining in extent. It is not to be regarded as the product of corals, like the great monument of organic life, the promontory of Florida. Professor Agassiz has, it is true, suggested that the sand reefs which fringe the Cape may be merely ancient coral reefs now serving as a basis of sand accumulations. It seems, indeed, natural to assume that these reefs, which continue to the northward, are the outlines of the coral barriers, or possibly have some relation thereto. Careful study, however, has shown that the changes which occur in this barrier are of such a character as to forbid our accepting this view. Passes open and close in the barrier, cutting apparently to its base which seems to be a dense clay. The truth is, these ridges of sand in the form of barrier reefs are common along the whole coast where moving sands occur, from Montauk Point to Mexico. They seem to be the necessary product of tidal action on any shore where there are large amounts of materials in a condition to be moved by the currents produced by the tides.

I have elsewhere endeavored to account for the presence of the enormous masses of detrital material which constitutes the broad reefs of Hatteras, and have shown that it is likely that the excavation of the great bays of the Chesapeake and Delaware was accomplished during the geological period just passing away; and that the excavating agents were the streams of ice which at that time poured down the valleys which debouch at the heads of these great inlets, just as the great alpine glaciers have in times past dug out the basins of the Swiss lakes. I have tried to show that the material so excavated, or at least a good part of it, drifted to the southward of these bays and went to form the great masses of reef material which make up the Hatteras bars and those which form the Eastern border of the broad waters of Eastern Virginia.

A revision of the evidence which led me to this opinion of the origin of the great bays of the Chesapeake and the Delaware, and secondly, of the source of the sands and muds which make the sand-bars and mud-flats to the south of them, has confirmed me in the opinion expressed a year ago. A glance at the map will show, however, that the fringing reefs of the Hatteras shore are only the antecedents of this part of the coast; remove them entirely and the difficulty of explaining the prominence of Cape Hatteras remains. Stripped of these reefs the shore would still present essentially the form it does at present.

A careful examination has satisfied me that the projection of Hatteras is due to subterranean disturbances which have resulted in uplifting the whole of this part of the coast. We shall have to go to some distance from the cape itself in order to find the evidence of this uplifting action. Upon a north and south line which passes through Richmond, Virginia, there exists a hitherto little noticed fold of the rocks having an altitude of over one thousand feet. On examining this ridge carefully, we shall find that it is elongated in the fashion of all great plications of rocks, and that it extends from Richmond, where it seems to sink down to the northward, as far as Weldon, N. C., having a length of at least fifty miles; its east and west development is much less, probably being not more than ten to fifteen miles at the base. On comparing the general character of this ridge with the separate ridges of the Alleghanies we find a very close resemblance. We are drawn to the conclusion that the similarity of form and the identity of direction indicate that this ridge is to be regarded as an outlying member of the Alleghany chain. It may, at first sight, seem an extravagance to term this ridge a mountain chain, it giving no conspicuous evidence of its existence on the surface. Although there is no external relief, the uplift of the rocks beneath the surface is as great as in the case of those ridges which still have a conspicuous relief.

The true explanation of this peculiarity is that this ridge has been to a great extent worn down, and covered by subsequent accumulations of sedimentary materials.

The geological structure of other points along this chain, to the eastward of the elevated region, indicates the same extensive erosive action as would have been required to reduce the Richmond elevation to its present height.

The upturned edges of the old series of rocks which crop out

along the line of the Manassas railroad, indicate that extensive reliefs once existing in that region have been worn away since the time of their upheaval. This erosive force I conjecture to have been brought into action by the successive periods of glacial activity which have probably operated in this region. It is in the highest degree improbable that the period of wide spread glaciation which has just passed away, was an unexampled accident in the history of our earth. It is, on the contrary, becoming more and more probable that we must accept glaciation as a recurring phenomenon, giving alternations in the action of the erosive force at work upon the surface of the continents ; at one time the streams acting in the local manner in which water works in its channels, again working over the whole surface of the country when its surface is ice covered to profound depths.

The glacial streams, which have dug out the vast excavations of the Chesapeake and Delaware Bays, must have been accompanied by lesser streams, or more likely by an almost continuous sheet of ice, pouring down the flanks of the mountain range along its whole extent. Supposing such repeated ice action, we should naturally expect to have many of the lower outlines of the range of mountains overridden by the rising streams and much ground by their action. The energy of the glacial action on the borders of a range is naturally much greater than in the central parts thereof; generally speaking, the weight of the ice sheet, and therefore its cutting power, increases from its sources towards the border. We should, on this as well as on other accounts, expect glaciation to be most destructive of reliefs, not in the centre of a chain but rather upon its borders. During the last glacial period in Switzerland, the great peaks of the inner region probably lost little, if anything, in height. Their summits covered with incoherent snow, or with *névé*, would be protected from external accidents; the lower regions alone, where the snow had become compacted, where it had gained its real glacial character, would be eroded.

It is not to glaciation or other erosion alone that we owe the disappearance of this, and probably other of the eastern outlines of the Alleghanies. There is abundant evidence of a considerable subsidence which has carried this and other summits below the bend which at one time they had. To see this point more clearly it will be necessary to look at some of the singular results obtained during the exploration of the Gulf stream by this survey. In the course of

the stream, in the latitude of Charleston, S. C., several parallel ridges were discovered which had a height of over one thousand feet; these ridges were, in their course, approximately parallel to the coast, and to the trend of the Alleghany range. The symmetrical relations of direction and arrangement existing between these submarine ridges and those of the Alleghany chain, at once suggest the existence of some relation of a genetic kind. The fact, hitherto unnoticed, of the existence of a ridge occupying a somewhat intermediate position between the Alleghanies and these submerged mountains, makes it not at all improbable that deeper down, beneath the more recent strata, there may be other similar ridges. I have elsewhere endeavored to show that the formation of mountain chains is necessarily limited to the land areas, or at least to those areas where there is no deposition of sedimentary material taking place. If this principle be correct, then we shall be safe in assuming that the submerged mountains, in the path of the Gulf stream above referred to, were formed above the level of the sea, and have since been submerged. Assuming that the continent has moved, as a whole, in this change of level, we should be compelled to suppose that the Alleghanies had lost over ten thousand feet of their altitude by this subsidence. It is possible, however, and this view derives probability from several sources, that the subsidence took place through the downward flexure of the section lying between the base of the Alleghanies, and the point where these submerged chains now lie. We shall see hereafter that there is evidence at hand to show that the coast of the continent, from a point somewhere between New York and the Chesapeake, is gradually subsiding, and that this subsidence has already gone so far as to depress recent accumulations to the depth of near one hundred feet at some points.

The question next in importance is that concerning the time of uplift of the Richmond axis. Passing to the east from Richmond we find at the distance of a few miles a set of coal bearing beds, dipping steeply to the west. The shafts of the coal field mines enable us to be sure that this dip amounts to over one thousand feet in the distance of three or four miles, at those points where the dip is least, and to two or three times this declivity at other points. The degree of inclination of these beds, together with the evidences of intense disturbance visible in every section through the coal bearing part of the series, makes it evident that they could not have been laid down in their present position. The presumption always is that coal beds have

been deposited in the form of swamp accumulations, and thus must have been laid down upon horizontal surfaces. There is every reason to suppose that the present condition and arrangement of the materials in the Dismal Swamp on the eastern side of the Richmond ridge exactly correspond to what was to be found in the region now occupied by the coal field we are considering, at the time when the vegetable matter of which it is composed was in the state of formation. Thus we have, on either side of a low dividing ridge, two basins of nearly equal size and comparable forms, the one holding vegetable matter, which has not yet been converted to coal, the other showing us an advanced state in this process of conversion. I know no other point where the process and the product of forming coal are shown so well together.

It is evident that if we could determine with accuracy the age of the beds which embrace the Richmond coal, we should thereby fix the most remote time at which this mass of the disturbing ridge had been uplifted. It was long ago perceived that the Richmond coal was not of the same age as the more extensive beds which lie to the westward. As yet the precise period to which it is to be referred is not yet determined. The first determinations of a trustworthy character assigned a Liassic age to the fossil plants found in the coal beds. Although these determinations have sometimes been called in question, no naturalist has ever yet assigned a time earlier than the Triassic period as the age when these beds were formed. Accepting these determinations, and of their trustworthy character there seems no occasion for doubt, we must conclude that the East Virginia uplift dates sometime later than the formation of the Alleghanies, provided the general opinion among geologists, which refers the elevation of that chain to the close of the carboniferous period, should be accepted as correct.

This is conclusive that two axes of elevation, coinciding in elevation very closely, yet of different age, is not in accordance with some of the views which were advanced by M. Elie de Beaumont, and for many years have had a singular influence upon the minds of geologists. The principal point in the theory of M. de Beaumont was that all chains, elevated at the same time, stand in a parallel relation to each other, even though they might be a hemisphere apart. In the same connection it was held that all the elements of the same chain, standing to each other in the sort of relation in which the seperate elements of the Appalachian system stand to each other, were uplifted at the same time. The extraordinary ability with which the

arguments were presented, rather than the number of well-ascertained facts which were adduced to support the theory, caused most geologists to give it their ready adherence. The criticisms of Mr. Charles Hopkins, together with more extensive and careful study of mountain chains, have caused a great decline in the estimation of this theory, so that we may not now fear to run counter to a generally accepted opinion in venturing to oppose M. de Beaumont's views.

In a subsequent report I hope to embody the result of some observations made upon the western flanks of the Alleghanies, showing the existence, in a position about as far west of their centre as the Richmond axis is east of that point, of a mountain range, which, though formed long anterior to the elevation of the principal mass of the Appalachian chain, is still parallel to it,—may in fact be regarded as the first step towards the formation of that singular mountain system.

Geologists have long known that the city of Cincinnati rests upon an elevation of the silurian rocks of the Ohio valley, the beds dipping gently away from that point. It has been always assumed that the dip was uniform in every direction, giving a true dome character to that elevation. Careful study of the region, however, has convinced me that the elevation is not a dome, but has a north-east by north, and a south-west by south trend, and extends as far as a similar elevation of the silurian rocks, which is found in western Tennessee, which elevation is, in fact, only the southern extremity of the Cincinnati axis. The direction of the line connecting these isolated patches of silurian rocks almost precisely coincides with the general trend of the Appalachian chain to the eastward. There are many reasons for believing that this Cincinnati axis was lifted above the sea early in the silurian period. The presence of considerable quantities of salt in the rocks of lower silurian age which flank this ridge, the existence of ancient beach marks in the rocks of the same age, and other phenomena, which cannot be properly discussed here, all point to the conclusion that this ridge was formed at a time when the silurian period had just begun, and while a large part, if not the whole, of what is now the highest part of the Alleghanies was still beneath the level of the sea. The existence of ridges of widely different ages on either side of the Appalachian chain, makes it questionable whether the central mass of that system is to be all referred to the same period as has hitherto been done; whether it may not be rather a congeries of elevations dating from periods of various ages, between

the age which we must assign to the Cincinnati and the Richmond axes.

It would be very important to determine the age of the several members of the central part of the Appalachian chain; as yet we have no data to make the basis of such a determination, nor do we even know the age of the rocks which compose the great mass of the chain to the south of the Pennsylvania line. It is quite evident that there has been a difference in the character of the movements which have produced the upheavals of the section from northern Virginia to the southward. To the north of that first-named line the chain is characterized by the absence of great faults. These dislocations are very frequent in the region to the southward. The existence of the hot springs of Virginia is due to the great dislocations of that region. The existence of a different class of irregularities in this part of the Alleghany chain, points to the conclusion that the conditions of elevation, and therefore likely the time of upheaval, was different from that of the mountains to the northward.

I am confident that the tertiary rocks which lie to the eastward of the Richmond ridge have been so far uplifted by the original or some subsequent elevation of this ridge, that they have had given to them the additional height which produces the projection of Cape Hatteras. Along the shore of the main land from Newbern, N. C., to Washington, at the mouth of the Roanoke, the hard, shelly limestone of the Tertiary period, looking much like the shell bed which is found near Charleston, S. C., comes to the surface just above high tide mark, and seems to be the principal barrier to the encroachment of the sea. At most points this shell bed is covered to the depth of several feet by an accumulation of vegetable mould, but before the last subsidence of this shore began it probably stood several feet higher. The dip of these beds is so slight that it is impossible to obtain any distinct indications of the slope. The relation of the beds is, therefore, to a certain extent, inferential.

We have determined that the Richmond axis must have been elevated since the close of the Palæozoic time. But we have found no reason to conclude that it must have been uplifted at or near that period in the earth's history. I am inclined to think that the only satisfactory evidence concerning the period at which this uplift occurred must be sought for at a point remote from this part of the coast, though closely connected with it geologically. The belt of rocks of a Triassic or Liassic age, to which the Richmond coal-field belongs, continues along

the foot of the Alleghany chain all the way from North Carolina to Vermont. Throughout this line it is more or less disturbed by dislocations, the directions of which coincide quite closely with that of the Richmond ridge and the faults of the coal-field just west of it. In Massachusetts these dislocations are distinctly seen in the great faults of the Connecticut valley which have given us the ridges of the Mounts Tom and Holyoke range, the Greenfield trap ridge, and many other similar reliefs.

If we could assume that these dislocations, which have cut up the Connecticut equivalents of the Richmond beds, were produced at the same time as the uplift of the Richmond axes, or the faults of its coal basin, we should be near the determination of the age of these disturbances.

The Connecticut river system of dislocation seems to be continued in parallel disturbances to the eastward, as far as Martha's Vineyard, the principal faults and folds of which have a north, south, and south-west trend. On this island the disturbances have upheaved beds of the Miocene age, so that we are led to suspect, on good grounds, that the whole system of north-west and south-west breaks, so extremely developed between this point and the foot of the Berkshire hills, are of this recent age. The recent look of the Connecticut valley dislocations, upon which the erosion which has always been active in this region has acted to a very slight extent, seems to corroborate this view; but it would be hazardous to say that the Virginia dislocations, which cut rocks of the same formation, and have near the same course, are to be regarded as of the same age. All that these correspondences can be regarded as establishing, is the probability of such a relation of age, a probability which must be carefully weighed with the other evidence before we can give it much weight. These Virginia dislocations have undoubtedly been much more eroded than those of Massachusetts, inasmuch as despite the powerful disturbance produced by the elevation of the Richmond axis, and the great faults of the coal basin, the region in which they occur is nearly level. There is reason to believe that the sea has worked more constantly against the reliefs produced by these dislocations than upon those of Massachusetts, which have probably never been subjected to the powerful erosion of the oceanic waves. Unless we can attribute the disappearance of all these irregularities of surface to some such difference of conditions, we must certainly assign to them a much earlier period of uplift. Taking the facts altogether, it seems reasonable to

conclude that the uplift took place after the tertiary series of rocks began to be laid down, and that the disturbance in the tertiary beds at Hatteras and Martha's Vineyard occurred during the same period of upheaval. It is not improbable also, that the whole of the disturbances of the Richmond axis did not take place at the same time, but at successive times, during two or more geological periods.

### CHANGES OF LEVEL OF THE HATTERAS COAST.

There is a change in the character of the surface of the country, as we pass southward from Petersburg. North of that point everything seems to indicate that the topography is the product of many thousand years of aerial erosion. As we go southward, the evidences of the atmospheric action grow steadily less and less manifest. At Gouldsboro' the streams seem to have had little to do with shaping the surface of the country. Their basins have but a slight slope towards the chánnel. But what topography there is seems to be entirely the result of river action in its broadest sense. The slopes are all those normal in river systems, though very slight. In the section from Gouldsboro' to Newbern, we observe, however, some decided peculiarities. Soon after passing the first-named place, on our way to the coast, there is an apparent diminution of height, and a gradual change of topography. The long, low ridges could not well have been formed by subaerial erosion. They do not lie normally to the course of the streams. I am satisfied that the topography is of submarine origin, as is that of the South Carolina coast above the Sea Islands. The long winrow-like ridges are, in shape, like those now found along many of the shoal, tide swept sea floors of our coast. The drainage seems to have found its way around these low reliefs when the country became uplifted, without changing them much. Generally the streams find their way around and between the ridges, rarely cutting them across. The behavior of the streams among these undulations reminds one very much of the way in which the streams in the Alleghany system cut their way across the series of ridges of that mountain region.

There is reason to believe that the subsidence of the land in this region is still going on, and that since the last considerable uplift there has been a sinking, amounting to several feet, at least. There are a variety of facts tending to support this conclusion, which are well established by the observations made since the settlement of the country. At Charleston, S. C., the phosphate bed which, at a point six

miles to the west of that city, is at the surface of the ground, is depressed to a depth of seventy-five feet, as was demonstrated by the section made by the artesian well at that point. The existence of a continued submergence at this point of our shore is a matter of great economic, as well as scientific importance. As no part of the easternmost one hundred miles of the State can be submerged to the depth of fifty feet without either becoming covered by the sea, or so liable to overflow as to be useless for cultivation, it follows that a sinking of a few feet a century is a matter of great concern to those who would anticipate the future of this part of our national area.

It is a well ascertained fact that a rise in the whole shore line from New York to Greenland has taken place since the close of the glacial period. This movement has most likely taken place in connection with the removal of the glacial sheet which, for some as yet unexplained reason, seems to have brought about a subsidence proportionate to the depth of the icy accumulation. It seems not at all unlikely that coincident with this re-elevation of the northern coast, there began a subsidence in the southern part of the Atlantic shore of the United States. It is certain that from New York southward to Charleston, there are, from point to point, indications of subsidence of a date about as recent as the elevation to the north of that point.

The form of the debouchures of the rivers which empty along this part of the coast, giving us the broad waters known as Albemarle and Pamplico Sounds, is not readily explained. Unlike the greater inlets of the Delaware and the Chesapeake on the north, these estuaries do not seem to have been formed by ice action. They are far shallower than those bays, and do not, like them, extend all the way from the shore to the hard rocks and high lands of the interior. It would be difficult to suppose that glacial action could have excavated their mouths and not cut out the upper part of their courses deeper than we find them to be. I am inclined to think that they have been formed much in the fashion of the estuary known as the Broad River in South Carolina. A river carrying comparatively little sediment, and thus having a small delta-forming power, has had its mouth gradually depressed by the sinking of the shore, and has thus naturally formed an estuary as wide as that part of the valley which was submerged.

It seems likely that at the time when the beds of these streams were first thus depressed the barrier of the Hatteras reefs had not been raised above the sea, and that the run of the tides in these

bays was far greater than at present. This would have contributed to cut away their shores of incoherent sand, and thus increase their width. If we examine the shores of Pamplico and Albemarle Sounds we find a tolerably regular correspondence between the direction of the major axis of the narrow bays and inlets which lead off the large sounds, and the course of the prevalent winds, showing a tendency to elongate in the direction of the run of the waves. This shows how far the development of the irregularities of this shore may be dependent upon the wear of the water currents.

Although my investigations of the geology of this part of our coast was carried on under great disadvantages, from the fact that deep snows covered the surface, and made detailed geological work impossible, yet there are some points in the economy of the subject upon which some information was gained. To the people of this region it is of great importance to determine whether the phosphate marls exist beneath their soil as in the coast region of South Carolina. I have not yet succeeded in finding the nodular phosphates in the Pamplico region. There can be no doubt, however, that the similarity in the geological structure of the country points to the probability of finding these valuable deposits in some parts of the shore region. A careful exploration of all the localities where there is a probability of finding the phosphates should be undertaken at the earliest opportunity.

Mr. J. B. Perry said, in regard to the Syenite underlying the coal, that there is no evidence of intrusion. The Syenite was in existence before the coal was laid down.

Mr. W. H. Niles remarked that the question which Prof. Shaler had discussed was one of great interest, and he considered his view consistent with all the physical features of our eastern coast. The deepest portion of the sea-bed lies opposite mountains, showing a parallelism between the Atlantic valley and the Appalachian System. The Cincinnati axis he thought instructive, because showing that all parallel chains were not raised at the same time. The long terrace of the Atlantic plain forms another parallel. The deposi-

[1] This paper is from a report on the geological history of Cape Hatteras, published by permission of Prof. B. Pierce, Superintendent of the U. S. Coast Survey.

tions are parallel with the mountain chains. He accepted Prof. Shaler's explanation of the elevation and depression of land in connection with water deposition.

He also showed that from the earliest time, in the Adirondacks, and at different points southerly, there had been peninsulas corresponding in position to Florida, which is the most southern and latest.

Prof. A. Hyatt said, beside the general westerly and easterly motion described by Prof. Shaler, there were evidences of a motion transverse to this along the coast.

Thus the north of Greenland, as shown by various Arctic explorations, has beaches recently elevated, and historical records, as well as direct observations, have proved that the southern portions of this peninsula are sinking. Dr. Packard's observations in Labrador give the evidence of a comparatively recent elevation, perhaps still in progress. Farther south, at the Mingan Islands, the speaker had observed a remarkable series of beaches, the lower still remaining near high water mark. On the island of Anticosta the remains of fresh water shells were found, evidently killed by the encroachments of the sea into the mouth of an estuary or brook, where the water had previously been fresh. There are two series of cliffs, stretching around the southern shore of this island, each about fifty feet high. The present level of high tide, however, now reaches to the foot of the inner line of cliffs, burying the crest of the outer line, which is only bare at low water. The shores of Nova Scotia, according to the observations of Hind, Gesner and Dawson, are sinking; those of New Brunswick and Eastern Maine rising. The shores of Western Maine, as shown by Dr. A. S. Packard, Dr. C. T. Jackson, and others, are rising. At Marblehead Neck, and along the Beverly shore, the speaker has observed several marks of recent elevation in beaches at the height of from eight to ten feet above high water mark.

The submarine forests of Holmes' Hole and Nantucket, described by Hitchcock, appear to indicate the beginning of another grand wave of subsidence. Observations made by the Coast Survey show that the coast of Long Island Sound, and southward in New Jersey, is sinking. The formation of Florida Keys on the other hand, ac-

cording to Agassiz, again evinces the action of elevating forces. These and other facts, which investigation would readily establish, prove that a series, or perhaps many series, of more or less local waves of elevation and depression run down the coast at right angles to the direction of the great waves which created the Appalachian folds.

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Section of Microscopy. Feb. 8, 1871.

Mr. E. Bicknell in the chair. Seven members present.

The Recording Secretary being absent, on motion of Mr. W. F. Whitney, Mr. A. H. Tuttle was appointed Secretary *pro tem.*

Mr. Chas. K. Stevens and Dr. Geo. B. Harriman were elected members of the Section.

The Chairman called attention to photographs of *Amphipleura pellucida* and *Surrirella gemma*, taken by Dr. Woodward, of the Army Medical Museum, and exhibited by Mr. Chas. Stodder.

Mr. A. H. Tuttle made some remarks on the fissiparous reproduction of *Stentor*, with reference to the direction of the plane of fission in *Stentor*, and in other ciliate infusoria.

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Feb. 15, 1871.

The President in the chair. Thirty-eight persons present.

The Secretary read the following paper:

On the Relations of the Class Brachiopoda. By W. H. Dall, Washington, D. C.

Having received a report, presumably correct, of some remarks by Mr. E. S. Morse in relation to my views of the relations of this class,

at a recent meeting of the Society, it would seem desirable to correct some erroneous inferences contained therein, and still further explain some disputed points from my own point of view.

Mr. Morse seems to think that I have not acted impartially in omitting to notice in my comparisons "nearly every point brought forward to prove the Annelidan character of the Brachiopods" and instances "the dorsal and ventral plates, the serial arrangement of setæ and gill laminæ, the bilobed lophophore, the cephalic collar, the thin and muscular visceral walls, the composition of the shell of *Lingula*, the cæcal prolongations of the mantle, and the presence of one or more pairs of segmental organs in form, character, and function like the segmental organs of the annelids."

In regard to this, it was distinctly stated that in the comparisons which I undertook, I included characters of high structural value alone, such as are almost universally acknowledged to be so by the naturalists of the present day, and not trivial characters peculiar to small groups, and due to adaptation and special development. This is a general answer, and I believe a sufficient one to Mr. Morse's criticisms, but I would add the following remarks to further explain the circumstances. All the so-called Annelidan characters brought forward by Mr. Morse in his published remarks on the subject, appear to me to be due to a series of extremely defective and entirely unproved homologies, which require much more evidence than has yet been brought forward, to confirm them.

That dorsal and ventral plates, serial arrangement of setæ and gills (other than such as exist in *Patella*), and segmented organs of any kind exist in the Brachiopods, remains to be proved; and as yet no evidence has been brought forward to sustain any such hypothesis. Such assertions must be supported by facts to render them worthy of notice and none have yet been adduced. I submit that such a statement as "*one pair of segmental organs*" in the absence of other segments with similar organs, is a contradiction in terms. Again, striated muscular fibre is not a characteristic of any group as distinguished from any other, according to Lebert, the best authority on the subject, and is, moreover, present in all classes of Mollusks, except the Cephalopod, where it may yet be found.

Mr. Morse complains that I have accepted Clark's definition of the Mollusca which includes the *Tunicata*, *Polyzoa* and *Brachiopoda*. If Clark's definition includes them by their principal structural characters, as I believe it does, it remains for Mr. Morse to give us a defini-

tion, equally good, which shall include the Brachiopods with the Annelids *Tunicata* and *Polyzoa* as opposed to the typical Mollusks. This he has yet failed to do.

Mr. Morse seems to think that I have omitted the unisegmental "vermes" in my comparison. I have not considered "segmentation," as properly understood, as a character at all. Segmentation is merely an adjunct, and the successive repetition of organs occurs without it, throughout the worms. The setæ of Brachiopods, sometimes entirely absent, are not arranged in successive series as are the setæ of worms. Furthermore, I have expressly avoided drawing any homology between the peduncle of *Lingula* and the siphon of *Mya*, but have pointed out that the histological structure of the two being identical it affords no basis for homologizing the peduncle of Brachiopods alone with any Annelidan organ. Nor have I stated or inferred anywhere, that the position of the setæ in Brachiopods prevents their identity in structure with those of Annelids, but I have proved that their structure is by no means identical, and any homology drawn from them is therefore erroneous.

I am at a loss to know the basis of the remark that I believe all Chætopods have setæ from head to tail, and trust that the inferences which Mr. Morse has drawn from certain supposed characters of Brachiopods are less erroneous than those which my paper appears to have afforded him.

In regard to Chitons, admitted to be Mollusks, though a very aberrant group, I have shown that their aberrancies are in some points similar to those of the Brachiopods, and therefore should not be taken in either as proofs that either group is non-Molluscan. Such homologies would afford a much more powerful argument for placing the Tunicates among the Vertebrates than any yet brought forward by Mr. Morse for placing the Brachiopods with the Worms.

Leuckhart, Gegenbaur and Hæckel, have, it is true, placed the *Polyzoa* and *Tunicata* among the "Vermes," but their views have not been adopted by naturalists, and proceed, as in my opinion do those of Mr. Morse, from a magnifying of certain unimportant characters and the overlooking of truly valid details of structure. Proofs have not been afforded of either view; when they are, it will be time to combat them.

With regard to the embryology of the *Polyzoa*, *Tunicata* and *Brachiopoda* it must be remembered that they differ among themselves in this regard, as widely as do any of the higher subkingdoms,

and also that our classifications are to be drawn from the mature characteristics and not from embryology alone, which would, if taken by itself, throw the study of all low forms into confusion.

In conclusion I would say, that, while adhering to the views entertained by the most eminent naturalists of the present day, I am by no means unwilling to modify my opinions when good cause is shown; but I cannot do so on vague and unproved statements, doubtful homologies, or supposed identity of trivial points of structure.

I look forward, as others do, to the publication of Mr. Morse's researches, with the greatest interest; and trust that the essential points of my arguments, which he has not attempted so far to refute or even to allude to, will be met with all the facts in his possession.

Truth will infallibly be established through such discussion, which is the final aim of all, and which will endure after the discussions are forgotten. While Allman, who has made a life-long study of the *Polyzoa*, finds the most intimate homologies between them and the Lamellibranchs, and Kovalevsky and Hæckel show the strongest embryological affinity between the Tunicates and Vertebrates, we may well pause in our speculations and more profitably devote ourselves to active research. Facts brought forward are immutable, while hypotheses and inferences depend on the individual observer, and in many cases have the most fleeting duration.

Mr. Wm. T. Brigham described the system of volcanoes in Mexico, which he said was arranged in a line between the West Indies and Hawaiian Islands. He referred to the geographical position of Orizaba, near Vera Cruz, which has recently been active. The first eruption took place in 1456-7. In 1569, another occurred, throwing up immense columns of ashes and boulders, which now resemble those that have been subjected to glacial action. It has since been quiet until last year, when it was again active, causing much destruction. In March, 1870, Ceborujo was in a state of activity. He read an interesting account of this eruption, showing its effects upon the magnetic needle. He next referred to the well known volcano Jorullo. In reply to a question from Dr. C. T. Jackson, he said that fishes six or eight inches in length had been taken from subterranean lakes in the vicinity of

Carguairaso, one of the Andes. Some of these lakes contain beds of diatoms twelve feet in thickness. He also made a brief reference to the multitude of extinct volcanoes in the vicinity of Ceborujo.

Dr. Charles Pickering, referring to an observation made by Dr. Jackson at the preceding meeting, to the effect that the central heat held water on the surface of the globe, said he had seen this exemplified on a small scale at Hawaii. All the water there is distilled by the heat below, condensed by the vegetation and collected in pools, from which the supplies were taken. Immediately after an eruption, when he visited the volcano, the crater was empty. He could detect no steam or vapor in the fields of lava. There rises from the lava a kind of smoke, which is very conspicuous. He could not say what it was, but thought it was not vapor. The winds there always blowing in one direction, he had visited the regions to leeward of the volcano and found quantities of "Pele's hair" in rolls. The eruption of Kilauea, he said, differs in some respects from that of Mauna Loa. In the latter, the lava breaking out eight or ten miles from the summit, flows eighty or ninety miles to the sea. The ascent of Kilauea is so gradual that it is difficult for one ascending to its summit to appreciate its altitude. The great crater does not overflow, but when full splits the island, opening a way for the lava thirty miles to the sea.

Mr. Brigham, referring to the opinion that water was necessary to an eruption, said, that with the ocean all around it, the vapor from this volcano is always dry. It is blown down toward the sea and its moisture, if it contained any, would be deposited, but the region over which it passes is dry and barren. He found it necessary to wear a wet cloth over his face to protect respiration while passing through it, and it was quickly dried. It is mixed with sulphur, but what gives its occasional black appearance, he could not say. The rocks

are so porous that water runs through them as it does through sand. The natives are obliged to place calabashes to catch the rain. Water which is filtered through the roofs of the caverns is perfectly pure.

Dr. Chas. T. Jackson referred to Etna as another instance of a volcano which does not overflow its crater. The lava breaks its way down by Monte Rosa. The openings of the crater of the volcano on the Island of Ischia also, is not at the summit but on the side of the mountain, and at Stromboli, visitors can stand on a table rock above the crater, while explosions are taking place every minute.

Mr. W. H. Niles spoke of an examination recently made by him of a quarry of the sandstone series at Montague, and referred to the extremely large size of the conglomerate pebbles found in that vicinity. He also exhibited specimens to illustrate the lateral change in a bed of conglomerate, at the Chestnut Hill Reservoir, Brighton, Mass. He showed pebbles of quartz, or of quartzose rock, from the conglomerate, which were from two to five inches in diameter, and not larger than many others there; only fifty-eight feet from these pebbles when in the rock, the same stratum was entirely a fine argillaceous slate, a specimen of which was shown. Also specimens of the intermediate rock were used to illustrate the nature of the change.

Dr. Pickering said that the conglomerate appears in almost every part of the globe. He had found it in the Pacific Islands, but he had seen it containing boulders, like that described by Prof. Niles, only on the Island of Madeira. In regard to the formation of conglomerate, he said we do not want the aid of sea or river, but only to conceive of the recent deposits, which we see about Boston, hardening into rock. He had tried in vain to find the conglomerate at Hawaii; the lava is amorphous and insoluble.

Mr. Brigham said he had found a conglomerate lava in one of the Hawaiian islands, containing rounded pebbles, which after having been broken, undergo a change in the arrangement of material. By weathering, they scale off, and on splitting them, they show a concentric arrangement, and can be peeled off in laminæ.

Dr. Jackson remarked, concerning Mr. Niles' two specimens, one of quartzite, the other of argillaceous slate, that the former resists, while the latter undergoes disintegration, though they lie together. The argillaceous clays consolidate around them and form slates.

Mr. Niles found the evidence of glacial action on the conglomerate, grinding down the hard and soft rocks to a smooth and level surface.

The President called attention to the perfect cast skin of a lizard, prepared by Mr. J. T. Ogden, and presented through Mr. R. C. Greenleaf to the Society. It was obtained with difficulty while the animal was in the act of swallowing it.

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## March 1, 1871.

The President in the chair. Thirty-eight persons present.

Dr. Thomas M. Brewer exhibited the egg of the Mooruk, *Casuarius Bennettii*, which the Society had recently purchased, and read from the Proceedings of the Zoological Society of London, an interesting account of this bird, which inhabits New Britain, and of its habits in domestication. It resembles in some respects the *Dinornis*.

Mr. Geo. Sceva exhibited some Hindoo skulls, and made the following remarks:—

I notice especially the shortness of the upper jaws and the frequent absence of the third molars.

The first specimen, from a person of about twenty-three years, had fourteen teeth in the upper jaw, all of which were well formed and free from any appearance of disease, but no trace of the third molars (or wisdom teeth) could be found. The posterior part of the jaw [maxillary tuberosity] presents the same appearance back of the second molars as that of European skulls back of the third molars. In the lower jaw the third molar is wanting on the left side, but is present on the right, its roots being crowded backward and upward into the ramus of the jaw.

In the second specimen (age about thirty years), the third molar is wanting on the right side of the upper jaw, and on both sides of the lower jaw. A section had been made with a fine saw, so that a portion of the bone in both jaws could be removed and the internal structure examined, but nothing was shown to indicate that the third molars had ever existed.

In the third specimen — of about the same age as the last — the third molars are present but are crowded backward, their crowns approaching near the external pterygoid plate; the lower jaw of this specimen had not been preserved.

In the fourth specimen (age about twenty years), the third molars are wanting on both sides. In this specimen is shown a remarkable displacement of one of the canine teeth. The deciduous canine on the left side, instead of being shed as usual at the age of about twelve years, has been retained, and the permanent canine is found after cutting away a thin plate of bone, completely inverted, the point of its crown appearing a little below the orbit of the eye. No trace, however, of the third molars is found.

A great displacement of the teeth might often be observed in European skulls, but the cases in which there had been no development of the third molars were exceedingly rare. In almost every case where a third molar did not appear in its normal position in European skulls, it might be found above, or between, the roots of the second molar, or in some other part of the jaw. In the lower jaw it had been found so far removed as to appear in the upper part

of the ramus, its crown reaching nearly to the level of the sigmoid notch, between the condyle and coronoid process.

I obtained these Hindoo skulls while in Calcutta, but as I did not observe this peculiarity of their dentition until I was preparing to leave, I was unable to obtain any information concerning them, except that they were found in some burial place where the bodies had been partially exposed by jackals.

I desire to call attention to two Hindoo skulls (numbered 141 and 126) from the Society's collection, in one of which the third molars are absent on both sides. In the other the third molar is wanting on the right side, but on the left there is a small tooth with a short, conical root, showing no tendency to division, and being less in diameter than that of the central incisor.

I have been informed by Dr. J. B. S. Jackson that the Museum of the Boston Society for Medical Improvement contains four Hindoo skulls, in two of which the third molars are wanting.

From the examinations which I have been able to make, I have thought that these cases are confined chiefly to one caste, or to some particular class of people inhabiting the lower part of Bengal.

I have examined the dentition of about four hundred European skulls, and I believe the cases where the third molars are wanting, either wholly, or in part, are less than one per cent., while in the class of people to which these East Indian skulls belong, they appeared to be absent in about fifteen per cent.

Although this last mentioned proportion could not be found in the inhabitants of India generally, and might — owing to the small number of skulls now examined — exceed slightly that of any particular class, yet I wish to call attention to the subject that it may be further investigated by any one having an opportunity for doing so.

Mr. W. T. Brigham (replying to an inquiry made by Mr. Sceva) said that when he visited India a few years ago, he had heard it reported that the mongous was able to resist the effects of the poison of the cobra by eating some kind of plant, but the accounts given were so various that nothing trustworthy could be obtained. He afterwards inquired of scientific men residing in the country concerning the report, and was told that they had no reason for believing it.

Mr. Sceva thought the mistakes which had been so often

made in supposing that the mongous could resist the effects of the cobra's poison, were easily accounted for.

The mongous, when attacking the cobra, would seize it by the neck or throat, and would usually retain its hold for a few seconds, at the same time sucking the blood from the large vessels in its neck.

Sometimes the snake and mongous would roll over together several times, and he had known people who were so ignorant of the habits and powers of these animals, as to suppose that during this time the weak jaws of the cobra were holding the mongous, and on seeing the blood about its head and mouth, would think that it came from wounds on its own body, received from the fangs of the cobra.

Another mistake was often made in supposing that the blood frequently seen on the cobra's nose comes from a wound inflicted there by the mongous. And assuming this to be the case, the question was often asked how the mongous could bite the cobra's nose without receiving in return wounds from the cobra's fangs. On carefully observing the movements of the cobra when snakes and other animals were put into its cage, Mr. Sceva had found that it would strike at them with its nose without opening its mouth, and in many instances the cobra, by striking past them, would bruise its nose on the side of the box, or against the wire netting in front, causing it to bleed. This had occurred in every case he had witnessed of its encounters with the mongous.

Dr. Fayrer had made the mistake in one of his first experiments, of thinking the mongous bitten when it was struck by the nose of the cobra, and as the mongous did not die, his report, published in the *Indian Medical Gazette*, stating that the animal was "bitten," was regarded by some as conclusive evidence that the poison must have entered the blood, but could produce no bad effect on it. Dr. Fayrer, however, soon discovered that when animals were put into a box with a cobra it was very difficult to tell — merely by watching the snake's movements — whether they were bitten

or not; and in nearly all the experiments made afterwards he had the animal secured, and the fangs of the snake applied to any part of the body required, or the poison taken from the snake and injected under the skin with a hypodermic syringe. Several experiments were made on the mongous by both methods, causing its death in every case.

Dr. Thomas Dwight, Jr., inquired if any one had attempted to give any reason for supposing that the mongous enjoyed a special immunity from the effects of the cobra poison.

Mr. Sceva said the habits of the animal were somewhat similar to those of the weasel. He thought no anatomist or physiologist would find anything to favor the presumption that its blood could withstand the action of cobra poison better than that of other animals of its kind, although he thought it probable that there might be those who would consider the mere fact of the mongous attacking and killing the cobra enough to warrant the belief that the animal was differently organized from others; and notwithstanding the best evidence to the contrary, there were those who still unreasonably believed that the mongous, by eating the cobra's flesh, could resist the action of the poison.

Dr. C. T. Jackson remarked that many think the hog is not affected by the poison of the rattlesnake, as it is known to attack and kill the snake.

Mr. Sceva believed that hogs would attack and kill poisonous snakes in almost every part of the world. He had never seen a hog at the commencement of his attack upon a poisonous snake, but on one occasion he had seen one with both fore feet on the snake's head and neck while he was tearing open the body with his teeth. He had met with many people in North and South America, and in India, who thought that the venom of snakes could not affect the hog, but this supposition had been proved by careful experiments to be incorrect. In India he had seen a hog bitten by a cobra on the ear and on the inside of the fore leg; the action of the poison and the time of its death were shown to be

about the same as in the case of dogs. Mr. Sceva had once travelled with a party of men from the Western States, who had provided themselves with two bottles of brandy and a bottle of hog's lard as antidotes for snake bites. They had no reason to give for using the lard, except that they thought the snake's poison could not affect the hog. Mr. Sceva had known several cases of recovery from the bite of the rattlesnake in California, where the men had drank freely of whiskey and brandy. He did not think the bite of this reptile so dangerous in the Northern States and California as in warmer places.

Dr. Jackson remarked that it is not so dangerous in California as in the States eastward of the Rocky Mountains.

Mr. Sceva, in reply to an inquiry by Mr. Putnam, said that the poison of many of the venomous snakes had been tried, both on themselves and on each other, without producing death.

Mr. Putnam mentioned a case in which the rattlesnake bit himself several times, and was not injured by its own venom.

Mr. Sceva mentioned an experiment in which a small quantity of blood from a poisoned fowl was injected into the flesh of another, and from the second into the third, death occurring in each case. He thought that the venom of all poisonous snakes acts in a similar manner on the blood, although varying greatly in power. A great deal depends on the quantity of poison thrown into the blood. A large and vigorous animal might survive the action of a minute quantity.

Capt. N. E. Atwood spoke of the Capelin, *Mallotus villosus*, one of the Salmonidæ. It does not come as far south as New England, but is abundant on the coast of Labrador, around Newfoundland, in the Straits of Belle Isle, and westward as far as the Gulf of St. Lawrence, also on the coast of Greenland. It resembles the smelt and is a migratory spe-

cies, as is generally the case with the fishes on the coast of Labrador. They come on the coast in great numbers, the cod accompanying and feeding upon them, but at first there are no females among them. The sexual marks are very prominent. The female resembles the common smelt, but the male is thicker, with a ridge of villous scales on each side, running the entire length of the body. The male is harder and better for bait. About a week after the arrival of the males, females begin to appear among them, but only in the proportion of about one to ten. The males disappear after milting, and in about a week the females follow, their stay on the coast continuing about three weeks. Some stragglers only remain, in such an emaciated condition that the cod will not take them.

He referred also to the disproportion in weight and number, in the different sexes of the Halibut. Nine-tenths are females, the largest of these weighing about one hundred and fifty pounds, while the largest males reach about sixty only.

Mr. F. W. Putnam mentioned a remarkable case occurring in a collection of fishes recently received by him, from the east coast of Africa. An eel had swallowed a spiny Chœtodon, of three times its own normal diameter, so that the fish appeared as a great lump distending the abdomen of the eel.

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March 15, 1871.

The President in the chair. Thirty-nine persons present.

Mr. Edward S. Morse referred to the communication of Mr. Wm. H. Dall, "On the Relations of the Brachiopoda," read at the preceding meeting.

He dealt with all the points treated of in Mr. Dall's communication, by reading, in both cases, Mr. Dall's first paper and his last communication side by side, and submitting the facts to the Society as to what Mr. Dall really said in his first paper, and the denials to the same in this last communication. As to Mr. Dall's personal opinions regarding improved homologies, and the doubts expressed regarding certain well known structural features of the Brachiopods, Mr. Morse would pass them over as the result of haste in discussing the question.

Prof. Hyatt said

My objections to Mr. Morse's classification have heretofore rested wholly upon the presumed affinities of the Polyzoa and Ascidia. I have been led by the similarities of the adult animals of the two groups, to partially follow Prof. Allman in his opinion, that these two groups are closely related. In a paper on the fresh water Polyzoa (Proceedings Essex Institute, Vol. IV.) I have compared them, but at the same time shown that the differences are much greater between the Polyzoa and Ascidia than between the former and Brachiopods. Thus, there is no muscular system in the Ascidia which can compare in any sense with that of the Polyzoa; and in transforming the Polyzoa into an Ascidian, Prof. Allman is obliged to violate this obvious difference, as well as to effect many changes which are not consistent with their organization. The nearer affinity of the Polyzoa and Brachiopoda is hardly questionable, since the investigations of Kovalewsky, who has shown us that the young Ascidians are apparently more like young vertebrata than they are like the young of the Polyzoa. The importance and value of the resemblances existing between the adult Polyzoön and the adult Ascidian, so far as they may be supposed to indicate any close affinity or community of origin, are thus doubly denied by the differences of form and structure, both in the adults and in the larvæ.

The Ascidians are also likely to be removed by these new discoveries, not only entirely away from the Polyzoa, but to an equal or greater distance from all the rest of the Mollusca; and even if we could, in the face of embryology, still maintain our comparison between the two structures, we should be contrasting the Polyzoa, not with a typical Mollusk, but with an animal whose own position is very uncertain. I can think of no fundamental molluscan characteristics, either in the Brachiopods or Polyzoa, which ally them with the

Lamellibranchs (clams), except those which join them still more closely to the Ascidia. Therefore it seems clear, that if we separate the Ascidia from the Lamellibranchs, which they so closely resemble in their general adult characteristics, on account of their different developments, we must also, in turn, divide the Polyzoan Ascidia, and should logically regard the similarities of the two as analogies arising in different structures, and not as affinities derived from some common ancestor. Thus cut off from its quondam molluscan allies, our Polyzoön has but one refuge; its development points concisely to a vermian ancestor, and to this source we must relegate both it and its nearest ally, the Brachiopod.

Mr. Morse called attention to the fact that Kovalewsky, Hæckel, Darwin and others had pointed out the relationship apparently seen in the embryo of certain Tunicates, and the typical idea of the vertebrate embryo. Without expressing an opinion for or against this view, it was interesting to remark that many eminent naturalists had seen reason to include the Tunicates with the Vermes; and in the supposed relation, on the other hand, of the Tunicates with the Vertebrates, it was interesting to recall two prominent features of the Vermes that are likewise prominent characters of the Vertebrates, namely: hairs or setæ secreted by follicles, and genitals in pairs, with infundibuliform orifices, suspended freely in the perivisceral cavity.

Dr. S. Kneeland gave an account of a trip which he made in 1870, by sea, from San Francisco to Panama, and presented a few specimens which he had collected. He described the climate, the general appearance of the coast, and incidents of the voyage, and referred to the habits of some of the sea birds and of the flying-fish.

Large petrels (*Puffinus cinereus*) began to appear, and followed us on the second day out. On alighting in the water, which they often do, they put forward their webbed feet, checking their headway in this manner, backing water, as it were, with the wings spread, before settling on the surface. They came round and near the steamer in

considerable numbers, but never alighted on it, as the booby of the Atlantic does. On account of the great length of their wings and the shortness of their legs, they cannot rise, like the gulls, directly from the water, but are obliged to run along the surface like the smaller petrels, beating the water with their feet until sufficiently elevated to use their wings.

Flying-fish also appeared, but were neither so numerous nor so large as in the Southern Atlantic. The ventrals were expanded like the pectorals in the act of flight, the former being much the smaller. They rose out of a perfectly smooth sea, showing that they are not mere skippers from the top of one wave to another; they could be seen to change their course, as well as to rise and fall, not unfrequently touching the longer, lower lobe of the tail to the surface, and again rising, as if they used the tail as a powerful spring. While the ventrals may have acted chiefly as a parachute, it seemed that the pectorals performed, by their almost imperceptible but rapid vibrations, the function of true flight. Another reason which leads me to think they perform a true flight, is the way in which they reënter the water. After reaching the end of their aerial course, they drop into the water with a splash, instead of making a gradual and gentle descent, like the flying-squirrel, flying-dragon, and other vertebrates with membranes acting as parachutes. The drying of the flying membrane in the air would prevent the small but numerous motions necessary for true flight, and the animal therefore suddenly drops when the membrane becomes stiff. I do not see how the drying of the pectorals would affect their action as parachutes.

At the same time were seen small Portuguese men-of-war (*Physalia*) no larger than an olive, and without the purple reflections of the larger ones, so often met with in the Atlantic. Whether these were the young, or full-grown individuals, I do not know. I saw none larger than these, and they were not numerous.

As we approached the coast off the Gulf of California, the petrels left us, and were replaced in an hour or two by white gulls, about the size of Bonaparte's gull, but either entirely white, or with a very slight lavender-blue tinge on the back and wings. These had an entirely different way of alighting and rising from the water; they did not push forward their feet to arrest their course, but circled round like pigeons until their headway was stopped, then quietly settled upon the water, immediately folding their wings. They also

rose directly from the surface without running along, as the larger-winged petrels did.

Dr. Kneeland also presented to the Society some specimens of copper ore from Chili, and beautiful green beetles worn as ornaments by the Brazilian ladies.

Rev. J. B. Perry conjectured that some of the so-called *Scolithi* in the Potsdam may be the peduncles of the Brachiopods. In confirmation of this he remarked that Brachiopods are found in considerable abundance in many of the primordial rocks. He also added that the probable traces of worms occur, not only in the Potsdam, but also in rocks of much greater age. What appear to be worm-burrows are found in rocks in Vermont, at least twenty-five thousand feet below the Potsdam sandstone. They, and other traces of worms, are said to occur in the oldest fossiliferous rocks in England and Ireland, namely, in the Longmynd rocks and several of the overlying primordial formations.

Mr. Morse said it might seem singular that in the Potsdam we should not find the shells, if these cases are the peduncles. This, however, is readily accounted for on the ground that the sandstone is not favorable to the preservation of organic remains.

Prof. Hyatt said Mr. Billings thought these cases were masses of sponge, on account of the presence of spiculæ in them, but they show themselves to be peduncles, by the swelling at the extremity.

Prof. Hyatt also read a letter from Mr. W. H. Dall, in which he presents a valuable specimen of a new Lingula, discovered by him, to the Society, with the request that Mr. Morse may have an opportunity to study the structure of the animal.

## Section of Entomology. March 22, 1871.

Mr. Edw. Burgess in the chair. Nine members present.

Mr. F. G. Sanborn exhibited the galls of *Cynips quercus-tubicola* O. S., and *C. quercus-lanæ* Fitch, together with specimens of the gall-makers and their parasites, all presented by Rev. E. C. Bolles, who obtained them in the Cumberland Mountains of Alabama. Mr. Sanborn also called the attention of the members to several trays of Longicorn Coleoptera recently presented by himself and others to the Society's cabinet, and systematically arranged and labelled by Mr. Philip S. Sprague. He also stated that the Society had been able to secure the services of this gentleman for an indefinite period, in the arrangement and preservation of the insect collection.

Mr. P. S. Sprague mentioned that he had noticed a perceptible power of motion in the antennæ of a *Pterostichus femoralis*, on removing it from alcohol, in which it had been kept two years; he alluded to a similar case of motion of the antennæ in a *Staphylinide* beetle, recorded by him at a previous meeting. Mr. Hollis Thayer had observed similar motions in specimens of beetles which had been in alcohol several days.

Mr. Edw. Burgess read an abstract of a letter recently received from our associate, Mr. Benj. P. Mann, now in the vicinity of Rio Janeiro, Brazil, in which he stated that he was engaged in studying the insects attacking the corn, and had found several species of Lepidoptera among them, which were identical with our northern forms.

April 5, 1871.

Vice President, Dr. Chas. T. Jackson, in the chair. Thirty-nine persons present.

Rev. Edwin C. Bolles of Salem, Joseph Stone of Charlestown, Thomas C. Felton, Walter Ela and W. G. Farlow of Cambridge, Richard W. Bender, Sidney E. Sargent, William R. Nichols, Fletcher M. Abbott and S. Dana Hayes of Boston, were elected Resident Members.

Prof. Edward S. Morse presented the following paper:—

On the Adaptive Coloration of Mollusca.

Naturalists have long recognized the curious cases oftentimes occurring, of the resemblance between the color of an animal and its immediate surroundings. It had been supposed that climatic influences, or peculiarities of food, or greater or less access to light had something to do with these coincidences. Mr. Alfred R. Wallace has shown that the varied phases of these phenomena could not be explained by such agents, and in a paper "On Mimicry and other protective resemblances among Animals," published in the *Westminster Review*, July, 1867, and since made widely public in his work on "Natural Selection" he shows that the singular resemblances between the colors of animals and their surroundings are mainly brought about by the protection afforded them through greater concealment. Many very interesting examples are then cited from the Vertebrates and Articulates in support of these views. Briefly may be mentioned as examples, the almost universal sand color of those animals inhabiting desert tracts; the white color of those animals living amid perpetual snows; the resemblance seen again and again between the color of many insects and the places they frequent. Among the hosts of examples cited by Mr. Wallace as illustrating plainly the views he advances, may be mentioned the many species of *Cicindela* or tiger beetle. The common English species, "*C. campestris*, frequents grassy banks and is of a beautiful green color, while *C. maritima*, which is found only on sandy sea shores, is of a pale bronzy yellow, so as to be almost invisible." He then states that a great number of species found by himself in the Malay Archipelago, were similarly protected. "The beautiful *Cicindela gloriosa*, of a deep

velvety green color, was only taken upon wet mossy stones in the bed of a mountain stream, where it was with difficulty detected. A large, brown species (*C. heros*) was found chiefly on dead leaves in forest paths; and one which was never seen except on the wet mud of salt marshes, was of a glossy olive so exactly the color of the mud as only to be distinguished when the sun shone, by its shadow. Where the sand beach was coralline and nearly white, I found a very pale *Cicindela*; wherever it was volcanic and black, a dark species of the same genus was sure to be met with."

But little attention has been given to adaptive coloring among the lower invertebrate animals. Darwin, in his last work on the "Descent of Man" calls attention to the statements of Hæckel that the transparency of the Medusæ and other floating animals is protective since their glass-like appearance renders them invisible to their enemies, though Wallace also alludes to this same feature (p. 258). Mr. Edward Burgess informs me of a species of Acaleph, *Polyclonia frondosa*, on the coast of Florida, which lives in the mud and is brown in color. Darwin while admitting that the transparency of these animals unquestionably aids them to escape the notice of their enemies, yet doubts whether the color of Mollusks affords similar protection. He says, "The colors do not appear in most cases to be of any use as a protection; they are probably the direct result, as in the lower classes, of the nature of the tissues, the patterns and sculpture of the shell depending on its manner of growth." Vol. I, p. 316.

In glancing over our New England Mollusca, however, it seems that we do have very clear evidences of protective adaptations among them, not only in their form, but more particularly in their color. It would seem strange indeed if this were not so since so many species of Mollusca form an important portion of the food of many fishes,[1] and also of certain species of birds.

[1] In an inlet near Salem the writer observed a school of minnows swimming along the bottom and as they approached a certain point darting right and left in great alarm. For some time the disturbing cause could not be found. On closer examination, however, a Cottus was seen to open his large mouth and take in several of the little fishes. The Cottus was so perfectly protected by its colors, that it was only recognized when the capacious mouth opened, and only then were the minnows alarmed. Just beyond in their track was a rusty tin fruit can, the little tin remaining on it reflecting the rays of the sun, and from this harmless object they all turned affrightedly away.

In this connection it would be interesting to inquire into the food of fishes in respect to their colors. Those fishes feeding upon Mollusca would certainly not require such protection for concealment as those living upon more active prey.

In a general way we recall the sombre colors of the shells of most species, varying through different shades of yellow, brown and green, in this respect resembling the sand, mud and rocks, or sea weed in or upon which they live, and we then recall by groups the land snails of our woods with their almost uniform brown tints, like the dead leaves or rotten wood in which they live.

The fresh water snails have similar shades to match their peculiar habitats.

The fresh water mussels, colored likewise brown, greenish or black, accord with their places of refuge.

Among the marine forms we notice the adaptive coloration of certain species very well marked. The common *Littorina* of the coast swarms on the bladder weed, the bulbous portions of which are olive brown in color, or yellowish according to age. The shells of the *Littorina* found upon it, present in their varieties these two colors and are limited to these colors, though now and then delicately banded specimens are seen.

*Purpura lapillus*, which generally hides beneath overhanging ledges, or is concealed under flat rocks, has generally a dirty white shell, with now and then a specimen bright yellow, or banded with brown. We are not aware of any fish that feeds upon this species, though in the almost universal white color of the species an adaptive color may be secured in resembling the white barnacles which oftentimes whiten the rocks by their numbers.

In pools left at low tide where the rocks are often clothed with the red calcareous algæ we find the little red Chiton. Certain *Mytili* are green. The young of the large *M. modiolus* has a rough coat of epidermal filaments looking like the aborescent growth of some Algæ or Hydroid.

The few species common to the mud flats exposed by the retreating tide are colored black or dark olive. *Ilyanassa obsoleta* has the shell black, while the soft parts are quite dark. A related form, *Nassa trivittata*, lives in more sandy places and has a similarly colored shell. *Rissoa minuta*, inhabiting mud flats, has a shell dark olive, or nearly black, while other species of *Rissoa* are much lighter in color. The fronds of the large Laminarian are frequented by *Lacuna vincta* and its variety *fusca*. The first is greenish or purplish horn color, with darker bands, while the variety *fusca* is uniformly dark brown or chestnut; the colors in both cases quite match the Laminarian upon which they are found. Another species of the same genus,

*Lacuna neritoidea*, Mr. Fuller has observed spawning on bladder weed and its yellowish tinge accords well with its surroundings. *Margarita helicina* I have found in numbers on the large Laminarian and on sea weed at low water mark, and its color is decidedly protective; while other species of *Margarita* dredged in deep water on shelly ground are whitish, pearly, or red.

The protective coloring of certain species is well seen upon stones dredged in deep water, the various mollusks adhering to them, closely resembling the calcareous algæ and the stones themselves.

Species peculiar to sand beaches are of various sand colored shades, as for example *Machæra*, *Mactra*, *Cochlodesma*, *Cyprina*, the little *Solenomya* and *Solen*. On muddy ground we notice certain *Tellinas* and other species with white shells. It has been supposed that those species hidden from the light were generally white, and this would seem to be the case when we recall *Mya*, certain species of *Teredo*, *Tellina*, *Pholas*, and other species. Yet we do have cases where the shell is oftentimes conspicuously banded or marked. It might appear that in those species living buried in the mud or sand, the shell was protected by a very thin epidermal layer, and that this layer was eroded, thus exposing the white shell; there are certain species, however, living buried in the mud or sand which have an epidermal coat very thick and dark brown or black, such examples are seen in *Solenomya borealis* and *Glycymeris siliqua*.

It has been noticed that the same species occupying different stations are differently colored. Dr. A. A. Gould noticed this in regard to *Astarte castanea*; those thrown up from deeper water are darker colored than those found in quiet sandy places. In his report on the Invertebrate Animals of Massachusetts, first edition, p. 78, speaking of the shells found in the sandy harbor of Provincetown, he says: "The color of all the shells in that harbor is remarkably light."

A very evident case of protective coloring is seen in the three species of *Crepidula* found on our coast. *Crepidula fornicata* is drab, variously rayed and mottled with brown, and it lives attached to stones near the roots of the large Laminarian or upon stones clothed with algæ of similar colors, or attached to the large *Mytilus*. *Crepidula convexa*, a much smaller species, lives on the roots of sea weed. Prof. Perkins records its occurrence on the black shell of *Ilyanassa obsoleta*. This *Crepidula* has a very dark brown shell, according well with the dark color of its various places of lodgement. *Crepidula plana* or *unguiformis* lives within the apertures of the shells of larger

species of Gasteropods, as *Buccinum*, *Natica*, *Busycon* and others. The shell of this *Crepidula* is absolutely white.

There are many species that undoubtedly receive protection in allowing foreign substances to grow upon their shells, and these species, oftentimes covered by a dense growth of calcareous or other algæ, are difficult of detection by the experienced collector.

There are also certain species that habitually accumulate foreign substances upon their shells. The little *Pisidium ferrugineum* possibly finds greater immunity from danger in its habit of accumulating a ferrugineous deposit on that portion of the shell most conspicuous. *Nucula delphinodonta* has likewise a similar habit. The delicate *Lyonsia arenosa*, with its habit of entangling particles of sand in its epidermal filaments, undoubtedly finds protection in this peculiarity.

It was not the intention to go outside of New England species in citing these examples, but in this connection I cannot forbear mentioning the tropical genus Phorus. The species are said to frequent rough bottoms and to scramble over the ground like the Strombs and not to glide evenly. This peculiar manner of moving would render them very conspicuous, and it is curious to observe that most of the species attach foreign substances to the margins of their shells as they grow, so that when a shell has attained its growth it is almost completely concealed by fragments of shells large and small, spines of Echini, bits of coral and stones.

These few observations are offered (and they might be multiplied) with the belief that if there is any truth in the theory of protective coloring as advanced by Wallace, the various colors of Mollusca in many cases can be explained, and the occurrence of varieties in color are also accounted for by the same theory.

Mr. Edwin Bicknell remarked that animals in preying upon each other were attracted more by the sense of smell than that of sight. He had noticed on one occasion, when jelly fishes were stranded, that numerous carnivorous snails, *Lacuna vincta*, were seen moving from all points towards them. He thought they could be directed only by a acute sense of smell.

Dr. B. Joy Jeffries called attention to the probability that the animals which prey upon those supposed to be protected by want of color, or by being of the color of their

surroundings, can not perhaps be accorded a power of color perception; and suggested that form and light may govern them in hunting for their prey. He also explained the difference between the red eyes of the albinos and others. With the opthalmoscope one sees in other eyes the same red reflections as in albinos.

Prof. A. Hyatt alluded to the color of the common Unios, or Anodons, as probably protective, and the well known case of the Melanias of the Western rivers, which are hardly distinguishable by the unpracticed eye, and to the peculiar and marked variations of the Siluroid fishes of the same region, which agree in color very closely with the ground on which they live.

Mr. Hyatt then continued, however, that he by no means desired to endorse the Darwinian doctrine of Natural Selection. A belief in evolution and the derivation of all higher forms, from lower and simple organisms, perhaps from inorganic matter itself, by means of secondary natural forces, is perfectly consistent with opposition to the Darwinian theory. According to this theory, new characteristics and therefore new kinds and species of animals arise by the survival of the fittest, as in a recent instance cited by the "*American Naturalist*," where a new race of deer is supposed to be in course of formation in the Southern Adirondacs. In this case, certain full grown bucks, about thirteen years ago were produced, with short stabbing horns like the young deer. These were thus enabled to drive away the branching horned forms during the rutting season, and to leave a larger number of descendants. These and their descendants, in turn enjoying similar advantages are, it is stated, gradually supplanting the branching horned deer in the Southern Adirondacs. The facts have been disputed and need the confirmation of farther observation and experience, but they form, perhaps, one of the best illustrations of the theory of natural selection ever recorded. Assuming, however, that it is true, and that a new species of deer is now being evolved in this region, what does natural selection really account for? It must account for the preservation and perpetuation of the branching horned variety, as well as the rise of the straight horns. The Anoplotherium of the Eocene, which has always been considered

by Owen and others, as the probable ancestor of the Cervidæ, had no horns even in the adult. The young deer when it is born has none, and the process by which they are acquired, takes place subsequently. The general characteristics of the deer's antler of the Miocene and Pliocene were simple, with only one tyne or prong like those of the young deer, and the palmate and extensively pronged horns were not brought out fully until the Post-pliocene. To-day, a decline seems to be taking place, since neither the reindeer or the moose equals the extinct Irish elk in the complexity and size of their horns.

If Darwinism can account for the propagation of this new race by the advantage which the short, stabbing horns gives to the bucks, how could any branching antlers ever have arisen from the Miocene deer. In accordance with the theory of natural or sexual selection, the horns should have become longer and sharper and have dropped their tynes, thus making them better weapons.

The reverse has certainly occurred, and antlers developed of extraordinary size, cumbersome and useless in comparison with the short, dagger-like horns of the Miocene deer. According to Darwin's latest modification in his Descent of Man, the increase in the size would be accounted for by sexual selection, namely, that the females would select the males having the largest horns, and thus the size of the horns would be increased in successive generations. If this be the explanation, how account for the rise of the short horned variety at the present time. Darwin quotes this instance as an example of Natural and Sexual Selection, in his last work, "The Descent of Man" (Vol. II, p. 243, Am. ed.)

Presuming, however, that natural selection does account for the evolution of the branching horns, and also for the preservation and gradual increase in number of the present spike horned bucks (as it may be fairly assumed in many instances, to act in the preservation and perpetuation of many characteristics), it neither does nor can account for the first appearance of horns, nor the first appearance of a full grown buck having the spike horns. The inadequacy of the theory of natural selection, to show us how characteristics arise, has been repeatedly insisted upon by several authors. Prof. Cope and the writer, in two widely separated departments, among the Reptiles on the one hand, and the Mollusks on the other, have repeatedly pointed out the mode in which characteristics, races, species and genera have arisen. Several writers on the European continent, and

St. George Mivart in his Genesis of Species, have lately taken similar views. The latter continually alludes to the sudden rise of species or races, and gives an instance of the sudden appearance of the black shouldered peacock in a flock of common peacocks. This variety, previously known in India as a separate species, speedily increased to the extinction of the original form. Here, as St. George Mivart points out, under different geographical influences, the same species has suddenly arisen in India and in England. No slow changes similar to those perpetually cited by Darwin and Wallace, no gradual fading of one species into another, but a sudden evolution of a new, distinct form.

Mivart too states, that "the view here advocated, regards the whole organic world as arising and going forward in one harmonious development, similar to that which displays itself in the growth and action of each separate individual organism. This apparently is the key note of his book." This was the view advocated by the speaker some four years previously, in the Memoirs of the Society, in a paper written to establish the fact that all characteristics had arisen suddenly among the Ammonites and Nautili of past geographical epochs. This paper was a short preliminary statement of facts observed, and it did not excite his surprise that Mivart had overlooked it. He could not, however, help wondering at the absolute silence preserved with relation to the essay of Prof. Cope, of Philadelphia. This had been issued at about the same time and independently, but advocated nearly the same views as regarded the sudden production of characteristics among the Reptiles, and must have been well known to Prof. Huxley, with whom Mivart seems to have taken council. This omission is by no means creditable to the author of a work written to refute such books as Darwin is in the habit of producing, and contrasts unfavorably with that writer's evident acquaintance with the essay alluded to above. This is shown most by the manner in which he is obliged to rest the proof of his assertion that species arise suddenly, upon a number of isolated facts, whereas either Prof. Cope's paper or the speaker's, especially the former, would have furnished him with a number of reliable and serially connected illustrations of the quick evolution of species.

Dr. S. Kneeland presented to the Society specimens of deep sea soundings, collected by Lieut. Breck off the Pacific coast, in three thousand three hundred fathoms, samples of

which he had already furnished to Count Pourtales for investigation.

Dr. Kneeland exhibited several specimens of glass, marble and hard stones, engraved, carved, and grooved by the action of sand driven by a blast of air or steam. The surface being covered by perforated paper or a stencil plate, the parts exposed by the perforations are cut rapidly and accurately, while the covered parts are untouched, protected, it is supposed, by the elasticity of the paper or thin metal.

He drew attention to this industrial process as illustrating the advantage of diffusing, as a common branch of knowledge, information on the forces of nature, and, in this instance, on dynamical geology. This process, which promises to revolutionize one of the most extensive of the industrial arts, is simply carrying out what natural forces have been doing to the surface rocks of our continent for ages.

Sands carried by strong and steady winds, passing over rocks, often wear them smooth or cover them with grooves and scratches, as noticed and figured by Mr. Blake, in the granite rocks at San Bernardino Pass, Cal.: see Pacific R. R. Reports, vol. v, pp. 92 and 231. Quartz rocks were there found polished, the softer felspar being cut away; where the latter had been protected by garnets, projections were left, tipped with the hard garnets, pointing like fingers in the direction of the wind. On the surface of the great Colorado desert the pebbles are finely polished by the drifting sand, or variously grooved, according to the hardness of their substance. Prof. J. Wyman also mentions that glass windows on Cape Cod have sometimes holes worn in them by the drifting sands blown by the winds.

It is the tendency of modern education to pay less attention to the dead languages and to ancient history, as a means of culture, and more to the practical and living issues of the day, and especially to combine a knowledge of natural phenomena with the elementary instruction of the school room. In this particular instance, it is altogether probable that, if the grooving of rocks by the wind-driven sands, long known by geologists and physicists, and by them turned to no practical account, had been equally well known to our intelligent and skilful mechanics, the process here illustrated would have been invented years ago, and by this time have attained a high degree of perfection. The same reasoning will apply to other departments of natural and physical science, and goes to show the wisdom

of those educators who are endeavoring to diffuse a knowledge of scientific principles and phenomena among the people.

Mr. L. S. Richards exhibited a stone taken from the excavations at Fort Hill, in this city, near Oliver Street, seventy-five feet below the surface, which, like the majority of the stones taken from the drift near this spot, was covered with "glacial" grooves and scratches. He had also found on the southerly side of the locality conglomerate in the process of formation without the action of heat.

## On the Relations of Anomia. By Edward S. Morse.

Under the name Anomia was included Terebratula by the early writers. Misled by external appearance, Linnæus, Lamarck and others believed Anomia and Terebratula to be closely related. While not the slightest ground existed for bringing them together, yet the mere fact of these two animals being enclosed within a living shell composed of two pieces, held to the rock by a process which passed out through that element of the shell which was undermost in both cases, furnished sufficient proof of their relationship to those who were ready to judge everything from external appearance.

The whales among fishes, the barnacles among mollusks, were only some of the blunders committed by this superficial way of comparison; and now after the external elements of the Brachiopods are admitted by all writers to be dorsal and ventral, while the valves of Anomia are right and left, and after the splendid memoir of Lacaze Duthier on the anatomy of Anomia[1] has shown that its nearest relations are with the Pectens, etc., there are still some writers who vaguely imagine that some sort of relationship exists between the two.

It is refreshing to turn back twenty years and find Forbes stating that "a close examination shows that there is no relationship of affinity between them, but only a resemblance through formal analogy."

This brief note is given to verify the correctness of a statement

[1] Organization of Anomia. Ann. Sc. Nat. 1854, II series, 5-35.

made by Forbes and Hanley in their standard work on the British Mollusca, wherein the shelly plug which escapes through the sinus of the flat valve to hold the animal to its base of attachment is compared to a byssus. They say "when the very young fry of this genus shall have been carefully observed, we believe they will be found spinning a byssus, which, passing through this sinus, fixes the shell in the first instance, before a portion of it becomes attached, eventually becomes detached with a part of the adductor muscle, and forms the opercular process." [1]

They erred only in conceiving that the byssus passed through a sinus occupying the same position as in the adult; this is not so, as will be shown presently.

Lacaze Duthier, after his exhaustive study of the organization of Anomia, refers to these

Fig. 1.

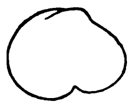

Fig. 2.

Fig. 3.

Fig. 4.

a

Fig. 5.

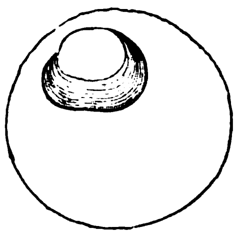

Fig. 6.

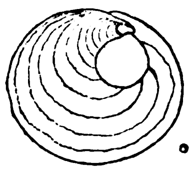

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**Fig. 1.** Right or lower valve of Anomia, showing notch in ventral pallial margin, caused by byssus. Diameter one sixty-fourth inch.

Fig. 2. Left or upper valve of Fig. 1. Diameter one sixty-fourth inch.

Fig. 3. Foramen commencing to form. The black portion shows proportions of left valve.

Fig. 4. A more advanced stage of right valve with foramen almost completed.

Fig. 5. Left or upper valve of Fig. 4. Diameter one thirty-second of an inch.

Fig. 6. Showing later stage, with foramen completed, and nucleus still visible.

[1] Forbes and Hanley, British Mollusca, Vol. II, p. 323.

statements of Forbes and Hanley, and expresses his belief in their correctness, and in describing some peculiar features of asymmetry, aptly calls them the Pleuronectes among mollusks.

In examining some dried sea weed collected by a friend of mine during the last week in March, I noticed some very young Anomiæ clinging to it. Unfortunately nothing but the little dried shells were left for examination, but as these presented some exceedingly interesting points as bearing upon the homology of the plug to the byssus, I may be excused for presenting such incomplete observations. The specimens were easily detached from the sea weed with the point of a knife, without fracturing the shells; they were consequently very lightly attached. The smallest specimens examined are quite orbicular, the upper, or left valve, is very tumid near the nucleus, the lower or right valve is flat and somewhat smaller than the upper valve. The foramen, or sinus, is not closed, but opens on the anterior border of the shell. The chief point of interest, however, is seen in the nucleus, or that portion of the shell first formed when the animal was free and roving. This early condition of the shell is distinctly marked at the beak in both valves. It is yellowish in color, and marked with numerous, very regular concentric lines of growth, while the remaining portion of the shell is colorless or white with irregular lines of increment. The nucleus is oblong-oval. The umbones are nearly central though nearer the anterior margin, and the shell is more globose behind. Both valves of the nucleus appear equally convex, and no sign of a sinus or perforation is visible in either valve. On the free edge of the right valve, directly under the umbo, a distinct notch is seen, the lines of growth indicating it, and showing that the edge of the shell is not absorbed to form this notch. It will be noticed that this marginal notch appears in that valve which is below, and which afterwards presents the opening for the passage of the byssal plug.

The condition of the shell at this time clearly indicates that the animal is not only already attached, but has fallen to one side, and while in this position has added a few more lines of increment to its larval shell, as no sign of this notch is seen on the left or free valve. Soon, however, the peculiar and rapid secretion of a different shell growth takes place; the lines of increment are no longer regular, nor so conspicuous, and the shelly matter is white. The left valve adds concentric layers around its entire margin, not excepting the hinge margin. The lower valve appears to grow from its posterior and

lower half, the successive accretions being produced around the byssus. This growth for a while seems to take place exclusively from the posterior half of the shell limited in front by the byssus, and even after this growth has increased to twice the diameter of the embryo shell only a slight increase is noticed on its anterior margin, this latter addition being slightly reflected.

The left or upper valve grows more rapidly, so that its margin overlaps the right valve at all points.

As the animal increases in size, the foramen increases also, and its earlier boundaries are consequently absorbed.

It will be seen by reference to the figures that the growth of the perforated valve is first posterior and downward, from the posterior half of the shell; it then grows forward, avoiding the byssal plug, and by successive additions surrounds the byssal plug and ultimately reaches the umbones of the larval shell, and even beyond and behind this region. From these facts it is obvious that at an early stage the animal is free, and for a time locomotive; that it has an elongate, oval, bivalve shell, with close and regular lines of accretion, and that during the latter stage of this growth it becomes attached by a byssus passing from between the valves as in Mytilus; that before the growth of the larval shell is completed, it drops over to one side, since one valve only shows the notch upon its margin, and that so soon as this growth ceases a new growth takes place, looser in texture, and white in color, as above described. In this excessive growth of the shell backward it is interesting to note that in the Mytilidæ the growth of the shell is almost entirely posterior, leaving the umbones at the extreme anterior portion of the shell.

It would appear that the larval shell is a true dimyarian and its affinities may possibly be quite remote from Ostrea or Pecten. A study of the early stages of the last named genera would easily remove all doubts upon these points.

Drs. J. B. S. Jackson and B. Joy Jeffries, and Messrs. R. C. Greenleaf, John Cummings, Jr., and Wm. H. Niles, were elected a Committee of Nomination, to present the names of candidates for the officers of the Society for the ensuing year.

Mr. Sanborn exhibited a valuable donation of alcoholic specimens of mammals, birds, fishes, reptiles, mollusks and insects from Florida, presented by Mr. Samuel N. Chamber-

lain, and called attention to the number of fine specimens of both sexes, of the double striped "walking-stick insect," the *Spectrum bivittatum* of Say; — a species that had hitherto been unrepresented in the Society's Cabinet.

The Secretary read a letter from Dr. T. M. Brewer, announcing a donation of bird-skins to the Society, from Mr. Thure Kumlein of Wisconsin, also a mounted *Erismatura dominica*, the second specimen known to have been taken in this country.

The following paper was presented: —

## INTERMEMBRAL HOMOLOGIES. BY BURT G. WILDER, M. D.,

Professor of Comp. Anat. and Zool., Cornell University, Ithaca, N. Y.

### INTRODUCTION.

The general correspondence of the limbs with each other was recognized by the ancients. The first detailed comparison was made by Vicq d'Azyr, in 1774. Since then the subject has received attention from nearly all anatomists, and there have come to my notice about seventy-five works wherein it is discussed. Of these about one half have appeared since 1860, and the number and eminence of their authors give reason for expecting much work to be done in coming years upon intermembral homologies. Yet so radical is the present difference of opinion among the more earnest workers, and so many and profound are the problems involved, that there is little hope of its final settlement within the present century. For several years I have lost no opportunity of collecting material upon the subject, and have announced my intention to devote myself chiefly to its investigation, in the hope of deciding one great question in homologies; but I had also resolved to publish no more upon the subject until I could begin the publication of a series of monographs treating in full of the various subdivisions of the question. My intention has been altered by the following circumstances: —

1. Several recent English writers have regarded the question as already decided in their favor, Flower, 66,[1] 240; Rolleston, 61, 219;

[1] The numbers refer to the bibliographical list at the close of this paper, the first number indicating the *work*, the last the *page*, and the middle one, when it occurs, the volume.

Humphrey, 72, 68; Mivart, 279, 163, in spite of the published opinions of Foltz, 39, Wyman, 55, and the writer. They hold that the relation of the membra is one of *syntropy* or *parallelism*, and that pollex (thumb) is the homologue of primus (great toe); we hold, on the contrary, that the relation of these parts is one of *analogy*, and that the true homologue of pollex is quintus (little toe), and that of minimus (little finger) primus, the membra being *antitropically* or *symmetrically* related.

2. During the past year a new and vigorous ally has entered the discussion. Dr. Coues' admirable papers, 70, have already been briefly noticed,[1] and will be reviewed at more length hereafter.[2] I now merely express my gratification and my hope that together, under the guidance of our eminent teacher, Professor Wyman, we may be able to show that a very small minority may yet be in the right.

3. I have recently been led to modify my previous views respecting the *normal position* of the membra in which they should be compared together, and I am anxious to admit this change since it involves a concession to those who hold the view of syntropy.

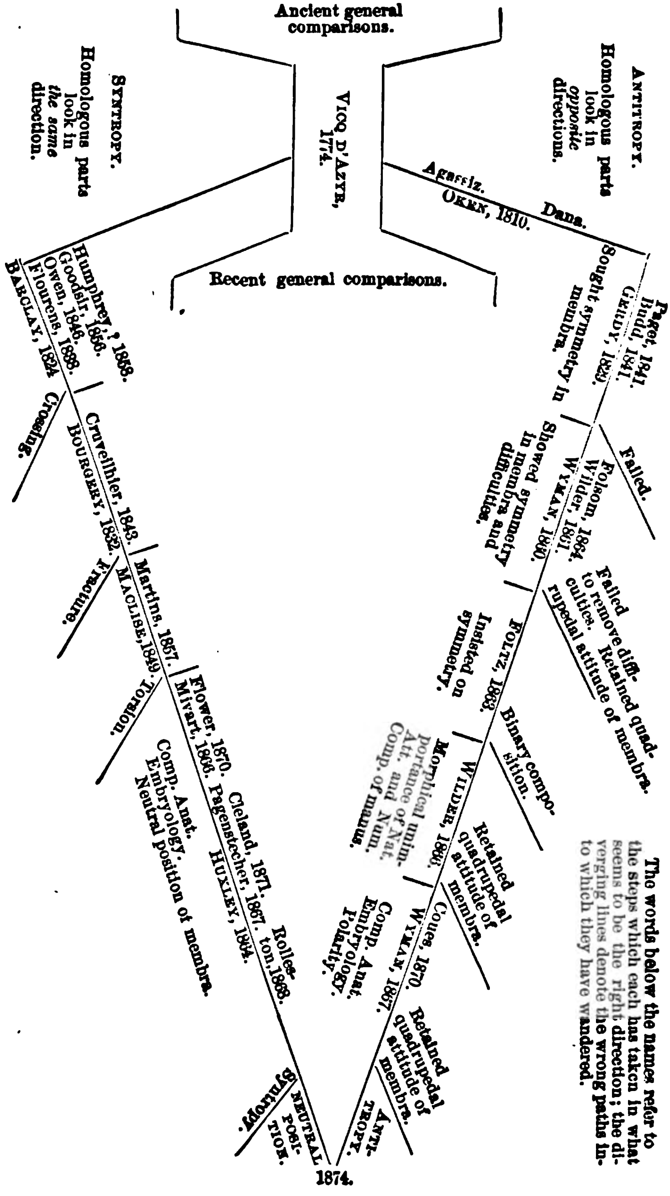
Still, the present paper is intended mainly as an index of what has been done, and of what remains to be done for intermembral homologies, and as a prodromus of the works which I hope to offer in coming years.

It will contain:—

1. An historical sketch of the question.
2. A revision of the nomenclature of parts.
3. A revision of the nomenclature of ideas.
4. Evidence as to the morphical unimportance of numerical composition.
5. Indication of general problems.
6. Indication of special problems.
7. Chronological list of special works upon intermembral homologies.
8. Alphabetical list of collateral works.
9. A glossary of morphological terms.

[1] American Naturalist, April, 1871.

[2] American Journal of Science, July, 1871.


Ancient general comparisons.
Recent general comparisons.
VICQ D'AZYR, 1774.
SYNTROPY. Homologous parts look in the same direction.
ANTITROPY. Homologous parts look in opposite directions.
Agassiz. OKEN, 1810. Dana.
Paget, 1841. Budd, 1841. GERDY, 1829. Sought symmetry in membra.
Failed.
Folsom, 1864. Wilder, 1861. WYMAN, 1860. Showed symmetry in membra and difficulties.
Failed to remove difficulties. Retained quadrupedal attitude of membra.
FOLTZ, 1863. Insisted on symmetry.
Binary composition.
WILDER, 1868. Morphical unimportance of Nat. Att. and Num. Comp. of manus.
Retained quadrupedal attitude of membra.
Coues, 1870. WYMAN, 1867. Comp. Anat. Embryology. Polarity.
Retained quadrupedal attitude of membra.
ANTITROPY.
Humphrey, ? 1858. Goodsir, 1856. Owen, 1846. Flourens, 1838. BARCLAY, 1824.
Crossing.
Cruveilhier, 1843. BOURGERY, 1832.
Fracture.
Martins, 1857. MACLISE, 1849.
Torsion.
Flower, 1870. Cleland, 1871. Rolleston, 1868. Mivart, 1866. Pagenstecher, 1867. HUXLEY, 1864.
Comp. Anat. Embryology. Neutral position of membra.
NEUTRAL POSITION.
Syntropy.
1874.
The words below the names refer to the steps which each has taken in what seems to be the right direction; the diverging lines denote the wrong paths into which they have wandered.

## I. HISTORICAL SKETCH.

I have ventured to represent the progress of the question of Intermembral Homologies since 1774, by the foregoing diagram. The brace at the left includes a reference to the general comparisons between armus,[1] (anterior limb), and skelos (posterior limb), which were made by the ancient anatomists and by their successors prior to 1774. Between these and the recent general comparisons, and forming a common point of convergence of the one, of divergence for the other, is the "detailed comparison" of Vicq d'Azyr.

It is not easy to do justice to this great anatomist's paper upon the membra, partly because it contains no figures, but chiefly because his words are capable of three different interpretations, which have served as the basis for as many distinct views of intermembral homologies.

Vicq d' Azyr seems to have had in his mind three ideas: —

1. That armus and skelos really correspond, not only as membra, but in detail.
2. That similar parts face in opposite directions.
3. That, therefore, in order to make a comparison more readily, it is *convenient* to place the armus of one side, *reversed*, against the skelos of the other side.

In brief, he wished to demonstrate a certain *proposition*; in so doing he recognized a certain *fact*, and therefore followed a certain *method*. His successors have all admitted the truth of the proposition, and the majority have gone no farther than to recognize the general correspondence between the several segments and articulations of the membra.

But those who have noted the admission by Vicq d' Azyr of an antagonism between these corresponding parts, whether or not they saw the importance of the principle of symmetry, have more or less distinctly recognized the fact, and have, therefore, followed his *method* of comparison as a *method*, and nothing more. This is evident from the words of Turenne, 21, Pagenstecher, 54, and Haughton, 62; and some, if not all of those who have been much criticized and even ridiculed (by Owen, 20, 335; Martins, 37; Wilder, 52; Wyman, 55) for the extraordinary methods adopted in making their comparisons, ought rather to be included among those who have followed Oken, in recognizing more or less distinctly the importance of this symmetrical antagonism as a law of organization.

[1] The nomenclature of parts will be discussed hereafter.

On the other hand, the *method* of comparison suggested by Vicq d' Azyr required that the armus of one side should be placed *parallel* with the skelos of the other. And this, with his frequent use of the term "parallèle," (by which I believe he really meant only *correspondence*,) has given rise to a class of views in which this method is in part adopted as an *end*, instead of a *means*; and the effort has been made in various ways to show that corresponding parts of the membra do, or at any rate should, face in the *same* direction. To this end, some have suggested ingenious serial homologies, leaving the parts in their natural attitudes, while others have altered the position of the membra or of their parts, in ways equally ingenious and plausible, yet, as I believe, equally unsound. But all these comparisons are based upon the generally received opinion that pollex (thumb), and primus (great toe), are homologous, which opinion I hold to be incorrect.

### SYNTROPY.

The former method of comparison originated with Dr. Barclay, the anatomical preceptor of Prof. Owen, who in 1824 suggested that the armus and skelos should be compared in their natural attitude with most mammalia, the manus pronated so as to bring the pollex upon the inner border of its membrum, as was the primus behind.

This involved a denial of the homology which Vicq d' Azyr admitted between the extensor surfaces of brachium (upper arm), and meros (thigh), and between the convexity of the ancon (elbow), and the genu (knee); and it further involved the comparison of two *parallel* bones, the tibia and fibula, with two *crossed* bones, the ulna and radius. Nevertheless, in 1838 Flourens proposed a similar view, 14, and in 1846 it was vigorously supported by Owen, 20, 335, and 63 in many places, who carried it so far as to find the homologue of the patella in the sesamoid bone of the *biceps brachii* in certain bats, and the homologue of the olecranon in the projecting post-genual process (fabella), of the wombat.

From this and other details of Owen's peculiar views, Goodsir dissents; but in 1856 he enunciated what seems to be essentially the theory of Barclay and Flourens, associating with it, however, a belief in the quinary composition of the membra, which had been suggested by Oken, 285, 2380, Duges, 11, 44, and Gervais, 27, 32.

I was formerly, 52, 486, inclined to include Humphrey among the "Antitropists," by reason of his recognition of the antagonism be-

tween the proximal parts of the membra, 34, 600, and 36, 16, which had been previously pointed out by Agassiz, 26, 89, and others; but a more careful study of his works, especially of his later papers upon the subject, 64, and 72, has led me to regard his views as essentially syntropical; since, in his opinion, the above-mentioned antagonism is purely telical, and involves no idea of a general principle of symmetry; so that his comparison of the membra must either be included among the recent general comparisons, or associated with those of Owen and Cleland, in spite of their disagreements in respect to some special homologies. To Humphrey, however, is to be given the credit of indicating the value of comparative anatomy in this discussion, as to Goodsir belongs the honor of urging the importance of embryological studies, in order to determine the "morphology of limbs."

The evident objection to a comparison of two parallel with two crossed bones, led Bourgery, 10, and afterward Cruveilhier, 18, to suggest that the tibia was represented by the upper half of the ulna and the lower half of the radius, and the fibula, in like manner, by the upper half of the radius and the lower half of the ulna; but their view has not been adopted by any later writers.

Equally unnatural and unsupported was the "Torsion" theory of Maclise, 23, and Martins, 33, who at different times, but as it appears, independently, endeavored to preserve the syntropy or serial homology of the membra, the natural attitude of the manus, and at the same time remove the objections to the views of Barclay and Bourgery by admitting the homology of the convexities of ancon and genu, and the parallel relation of ulna and radius; they assumed that "the humerus was a bone twisted upon its axis for 180°," and that it required to be *untwisted* in order to make the armus comparable with the skelos. A certain amount of "torsion" has lately been admitted by Gegenbaur, 59, but the conclusions of Maclise and Martins have been adopted by no other anatomists, and have been objected to by Humphrey, 36, Wilder, 45, and Wyman, 55.

A reaction from these speculative views took place in 1864, when Prof. Huxley proposed a comparison of the membra, 42, which differs in many respects from all others, even in the manner of its presentation; since its author appears to have attached so little importance to it that he has never written it out for publication or referred to it in his later works; and so far from believing, like the author of 23, that his method of comparison was to "unravel the gordian knot of that

problem which had so long existed as a mystery for the morphologist," Professor Huxley admits that "it cannot be considered as thoroughly satisfactory since it has not been checked by the aid of the complete study of the development of the parts in question, the only method by which any morphological problem can be determined." The precise value of development in the determination of homologies will be discussed hereafter, but there can be no question that too little importance had been given to it in previous comparisons of the membra.

"Professor Huxley instituted a new comparison of the limbs, placed not in the position which they assume in adult life, but in the only one in which they really correspond with each other, viz., that which they first exhibit in the embryo. In this condition they stand out at right angles from the body, the extensor surfaces being placed dorsally, and the flexor surfaces ventrally, with both pairs of limbs. They then gradually become bent and afterward acquire the modified position which suits them for their function in life, and to which their various articulations become adapted. The embryonic position continues throughout life in many amphibia and reptiles and without much change in galeopithecus."

Huxley then proceeds to compare the premembral (anterior) borders of the membra together, making the radius and pollex homologous with the tibia and primus, upon the generally accepted principle of syntropy or serial homology; not realizing that the very same regard for the facts of development which led him to ignore the subsequent flexure and attitudes of the membra, should also require him to give no heed to those secondary modifications of the primordial buds which differentiate pollex and primus from their fellows, and cause them to resemble each other in many higher animals; but aside from his special interpretation of homologies, I am now ready to accept his method of placing the membra for comparison as the true one, of which more hereafter.

This general view of the method to be pursued in determining intermembral homologies has been adopted by Mivart in 1866, by Pagenstecher in 1867, by Rolleston in 1868, and by Flower in 1870; who, however, have each proposed modifications in detail, which I will not discuss here, since the special interpretations of muscular homologies depend upon the general view of membral homology, and stand or fall therewith.

Parker has not expressed a decided opinion upon the subject; let

us hope that his late magnificent contribution to rational homology, 292, may be followed by a like work upon the membra, as a sound basis for all subsequent investigation.

Cleland has published two short papers upon intermembral homologies, 47 and 65; in the first he inclines to the general views of Goodsir, and in the latter makes the lower jaw serially homologous with the membra; but he kindly permits me to state that he is by no means satisfied with the present aspect of the question, and is even willing to admit the existence of "symmetry" in certain corporeal organs; so that I venture to hope that he may yet recognize the antitropic relation of the membra, especially since I am now ready to agree with him that the antagonism of the membral flexures in many mammals, is the result of telical modifications of their primary and normal condition; therefore, in spite of his previous views, and his disagreement in detail with the muscular homologies of the others, he may not object to being enumerated among those who follow Huxley in basing their further investigation of intermembral homologies upon the facts of comparative anatomy and embryology rather than upon anthropotomy.

## ANTITROPY.

The suggestion that a symmetrical relation or antagonism exists between the cephalic and caudal regions of the vertebrate body, is contained in many paragraphs of Oken's Physio-philosophy, 285, Par. 2114, 2242, 2951, etc., and has been since alluded to by Agassiz,[1] and Dana[2]; but these eminent naturalists have never published any direct application of the idea to the membra, although it cannot be doubted that Oken would now be among the first to adopt the antitropical comparison, as Agassiz and Dana have privately done.[3]

The first published comparison of the membra upon the basis of antitropy was that of Gerdy in 1829, 9; he appears to have been an artist as well as an anatomist, and to have been thus led to look upon the whole body as a symmetrical structure, whose upper and lower ends repeat each other in opposite directions as do the right and left sides; he began to apply this principle to the membra, but unfor-

[1] Contrib. to the Nat. Hist. of the United States, Vol. I, pp. 308, 311, 312.

[2] Am. Jour. Science and Arts, Nov. 1863, p. 351.

[3] Prof. Agassiz also informs me that in Europe he noted the symmetrical relations between the manus and pes of the walrus, and afterward discussed the whole subject in a course of unpublished lectures at the Smithsonian Institution.

tunately employed those of man in the erect attitude, and was, moreover so impressed with the prevailing belief that pollex and primus must correspond, that he failed to discover the existence of the idea of symmetry in the distal portions of the membra.

A few years later, Budd, 79, and Paget, 80, observed some pathological evidences of a relation between symmetry and disease, to which I have made some additions in 50.

A more successful attempt to ascertain how far the membra are truly symmetrical structures, not in a telical sense, as Humphrey regarded them, but upon the basis of the ideas suggested by Oken and Gerdy, was made by Professor Wyman in 1860, 35. In a verbal communication which it was my good fortune to hear, this eminent anatomist clearly and impartially stated the views of previous authors, and pointed out the objections thereto; no report is given of this remarkable communication, but as I recollect it, being then a student, and hearing of the subject for the first time, Professor Wyman expressed himself substantially as follows:—

"In order to compare the upper and lower limbs of man, the skeleton should be placed in a horizontal attitude; the limbs then hang downward; in their natural attitude, with most mammalia, the elbow looks backward and the knee forward; the shafts of the humerus and femur are inclined in opposite directions; if now the hand be *supinated*, and the fingers pointed backward, there results a complete symmetrical homology between all parts, until we come to the thumb and great toe; for the former is now upon the outer border of its limb, and thus opposed to the little toe; this difficulty is a very serious one, and there seems to be no satisfactory method of removing it."

This view of the limbs was afterward freely discussed by Professor Wyman in his laboratory, and was made the basis of later and decided expressions of opinion by Folsom, 40, and myself, 45, who were not then able to perceive the full force of the objections which our preceptor had indicated to his own view.

Three years later, but apparently unaware that Prof. Wyman had treated the subject, Dr. Foltz published his very valuable papers, 39, in which the general subject of symmetry is ably discussed and shown to exist between the membra, even to the digits and dactyls; but, excepting the supination of the manus so as to face the palm forward as the sole faces backward, Foltz retains the quadrupedal attitude of the membra, and further encumbers his theory with the

hypothesis of the "binary composition" of the pollex and primus, in order to get rid of the difficulty caused by their size in man; this makes us all normally sexdigitists; and as no sufficient reasons are given for this part of the view, and as man is the only species in which this special difficulty would arise, and as *size* is now admitted to be of very slight morphical importance, no one has adopted the view of binary composition of the pollex and primus.

My own contributions to the solution of this problem originated in the effort to remove the difficulties pointed out by Wyman, by suggesting that the morphical value of the manus and pollex was inversely to their telical importance, and that any difficulty with them should not be allowed to outweigh the teachings of the proximal portions of the membra; this suggestion was contained in my graduation thesis in 1862; and more fully presented in 1865; the same view was advocated in subsequent papers, 51, 52, 57 and 58, together with another respecting the morphical unimportance of the character "numerical composition"; both these points, with the distinction between natural attitude and normal position, I regard as demanding careful study in this connection, and they will be discussed hereafter; but in the above papers, I followed Wyman and the rest in comparing the membra in the condition they present in the quadrupeds, which I now believe to be *not* their normal condition.

In compliance with the oft-repeated request of former students and others interested in the subject, Prof. Wyman at length completed and published his paper on Symmetry and Homology in Limbs; 55. In the words of a reviewer, "certainly no modern inquirer has searched the secrets of Nature more closely, or clothed his discoveries in more concise and modest language." After showing that "in right and left parts distorted symmetry is the exception, while in the fore and hind (cephalic and caudal) parts of adults it is the rule," Wyman points out the remarkable analogy which exists between symmetry as brought about by vital forces and the effects of physical polarity; then discusses the signification of *homology*, and concludes, "those parts of the limbs will be homotypes which have the same relative position and are symetrically placed with regard to each other." p. 260.

He then compares the various parts of the membra as symmetrical structures, "repeating each other in a reversed manner from before backwards as right and left parts do from side to side, because, though open to grave objections, the difficulties met with, are, on the

whole, fewer than in the other, and because too, it is supported by the indications of fore and hind symmetry in other parts of the body" (p. 246); the objections are the same as were stated by him seven years before, and relate to the thumb and great toe, which are "assumed by most anatomists to be homotypes; first, on account of their relative size; second, because they have similar relative positions in the ordinary attitude of the fore arm; thirdly and chiefly, because they have only two phalanges each, while each of the other digits has three or more" (p. 276). The first two objections to a symmetrical homology of the parts, which brings the thumb as homologue of the little toe, are removed by showing first, that "the attribute of *size* loses its value when studied in the lower animals"; and second, that the natural attitude of the hand is a "false position" due to the "rotation of the fore arm in the embryo, but for which the thumb would have been on the outside of the hand, and would consequently have conformed to the position of the little toe." But the third difficulty "forms the greatest in our way and is not so easily disposed of; and we must rest content with the assumption that the thumb with its two phalanges is the homologue of the little toe with its three phalanges." (p. 277.)

The complete removal of this difficulty is one of the chief aims of the present paper, and will be the subject of a section upon the "morphical unimportance of numerical composition."

Prof. Wyman makes a valuable suggestion (p. 274) as to the normal shape of the carpal and tarsal bones, the metacarpals and metatarsals (p. 275), which is capable of application to all the long bones of the membra, and had been even adopted by Mivart, 46,401, with respect to the scapula and ilium; if all the long bones had been regarded as morphically columnar and cylindrical, the theory of "torsion" would never have taken the form it did.

Like Huxley, Wyman lays great stress upon the importance of comparative anatomy and embryology in this connection, but appears not to have seen the former's paper, since he does not allude to the method of comparison suggested by him, namely, by placing the membra parallel with each other and at right angles with the trunk, the convexities of the ancon and genu looking upward as with embryos and many lower vertebrates; and as this is the visual method which now seems to me most likely to lead toward a final solution of the question, the lack of allusion to it and agreement with it, appears

to constitute the main defect in the work of my illustrious preceptor as a complete guide to the future study of intermembral homologies.[1]

The same general criticism is applicable to the admirable series of papers by Dr. Coues, which appeared during the past year. The author follows closely in the footsteps of Wyman, "not blindly but unable not to see the validity of his arguments," 70, 195, and therefore with a few minor differences, or doubts respecting details, adopts the osseous homologies of Wyman as the basis for the determination of the "muscular correspondences." In respect to these, although Dr. Coues is led to differ materially upon some points from my own previous conclusions, 45, yet he has generally shown such good reasons therefor, that my approval of this part of his work is unqualified, and I am anxious to go over the whole ground anew in the light of his able discussion. In two other respects, however, I am forced to criticise his work.

In the first place, he has "no acknowledgements to make excepting to three authors,"[2] 70, 149, and therefore, whatever satisfaction may be derived from having so taken up the subject fresh, he has also lost the benefit of the check which an acquaintance with many and different views exerts upon the tendency to the exclusive adoption of any one.

In the second place, he has, in my opinion, adopted a faulty method from each of his predecessors. He has intentionally followed Owen, in the use of many different and often ponderous expressions for the same idea in order to avoid monotony, 193, note; whereas, in homologies, as in mathematics, each object and idea should be known by a single term and by that alone; since of all

[1] "It may at first appear that too much stress is laid upon this point, since, as Dr. Coues has suggested to me, the principle is right and the same parts are antitropically compared, whatever be the attitude of the membra; but it must be borne in mind that this matter, so trivial in the eyes of a zealous antitropist like my morphological brother, is a stumbling block in the way of the confirmed syntropists who constitute the vast majority of anatomists. They deny the law of symmetry at the outset, on the ground that its chief evidences are the natural antagonistic flexures of the membra which exist in a few quadrupeds only, and not in the earlier stages of development. And in vigorously opposing this unnecessary corollary of our theorem, they get into a frame of mind wholly unfit to receive sounder evidence of the theorem itself; like 'binary composition' the 'quadrupedal attitude' is an uncalled for, though natural amendment, to the measure of antitropy which we support."

[2] Owen, Wyman and the writer.

the natural sciences, this demands the closest attention, and the absence of all unessential considerations.

Coues has accepted unquestioned the view of the normal position of the membra, for comparison, which was first proposed by Wyman and adopted by Foltz, Folsom, and myself; this view is based upon the proposition of Wyman, 55,265, that "the knees and elbows in all animals are bent so as to form angles pointing in opposite directions"; if we except the fishes, this generalization is correct, *provided* that the membra are placed in the position they have with most quadrupeds; but Goodsir, Humphrey and Huxley and Wyman himself have shown that this is not their primary position, and it is quite possible that both Wyman and Coues might have followed Huxley in denying that it is their *normal* position, had they read his paper.[1]

Finally Dr. Coues has accepted from the writer a terminology of ideas (antitypy, etc.) which was itself based upon the Owenian phraseology, which was in no way expressive of the ideas designated thereby, and which I now propose to discard for a more significant nomenclature derived from the word which begins this section; of which more hereafter.

I have commented upon Dr. Coues' methods the more freely because, as regards the use of many and lengthy words, and the acceptance of single authors' peculiar views, my own sins have been more and greater than his can ever be.

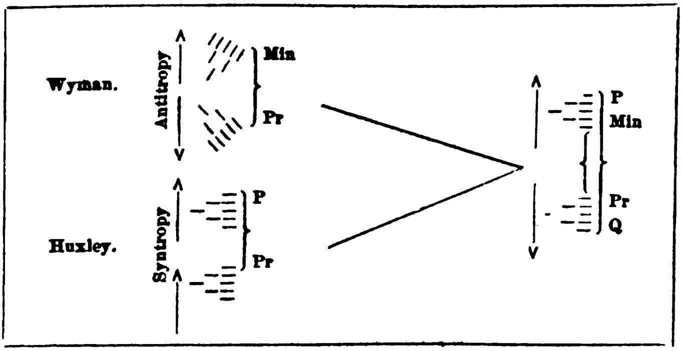
Dr. Coues may be glad to know that it is only since reading his papers, and during the careful review of the whole subject in preparation of this paper, that I have been led to modify my own opinion in regard to the position in which the membra are to be compared together, and to adopt the view of Huxley already referred to. If he will join me in this[2] — and still better, if the great anatomist to whose example and advice we both owe so much of our encouragement to this kind of work,—will yield his adherence to this new method of comparison, we may be bold enough to hope to close the first century of this controversy by proposing a view embracing

[1] Dr. Coues writes me (Dec. 23, 1871) that he sees no valid objection to the neutral position proposed by Huxley.

[2] Let me here thank my kind preceptor and my other scientific friends for allowing me to be the first to express the opinion that a certain memoir, 45, whereof the writer was rather proud, would have been the better for much cutting and pruning in the above mentioned respects, although I have no reason to regret the general views therein advocated.

the best elements of both the two great parties, Syntropists and Antitropists; the Realists and the Idealists they may also be called, since the former based their views upon certain facts to which were given undue prominence, while the latter began with the recognition of a great principle, which they sought to trace in all parts of the body; they may also be called the Peripheralists and the Centralists, since the former began their comparisons at the distal extremities of the membra and made the rest conform thereto, while the latter began with the evidences of symmetry in the body itself, and hoped to find the same law illustrated in the appendages; and finally the two schools are essentially of the Teleologists and Morphologists, since the former always laid great stress upon the functional correspondence of the pollex and primus, while the latter sought for the evidences of an abstract, morphical law of organization, and only failed in that search through lack of discrimination between morphical and telical attitude, form, and composition.[1]

Professors Huxley and Wyman are universally recognized as leaders of these two parties: both are anatomists of the highest rank and the latter has never been known to fully adopt a view which has afterward proved unsound: both admit the difficulties which beset this problem and, unlike some of their predecessors, make no pretence of "cutting the Gordian knot"; finally both have strongly urged the great importance of embryology and comparative anatomy.




[1] Among the notes made about the time of giving a course of University Lectures in Cambridge, Mass., I find the following: "It will be curious if the matter is finally compromised by adopting the view as to the position of the limbs proposed by Huxley, and making our own interpretation of Symmetry"; dated Feb. 15th, 1868.

It is probable, therefore, that for the final solution of this problem, we must combine the *visual* method of Huxley, as based upon the facts of position in embryo and lower animals, with the *intellectual* method of Wyman, as based upon a great law of organization. This convergence of the two opposing theories of Syntropy and Antitropy is indicated in our first diagram of authors, and may be seen still more plainly in the preceding figure.

In that diagram the arrows represent the longitudinal axis of the body; they look in the same direction in the lower figure, in opposite directions in the upper; in the lower figure the membra of the right side are shown in the *position* suggested by Huxley; but the brace still connects pollex (P) and primus (Pr.), which according to syntropy are homologous parts; in the upper figure the membra are turned away from each other as wholes, but the special flexures could be shown only from the side; here the brace joins the minimus (Min.) and primus (Pr.), which are homologous, according to antitropy. The *position* of the membra in the one, and the *idea* of symmetry in the other of these two figures are united in the third, where the braces can join pollex and quintus, minimus and primus.[1]

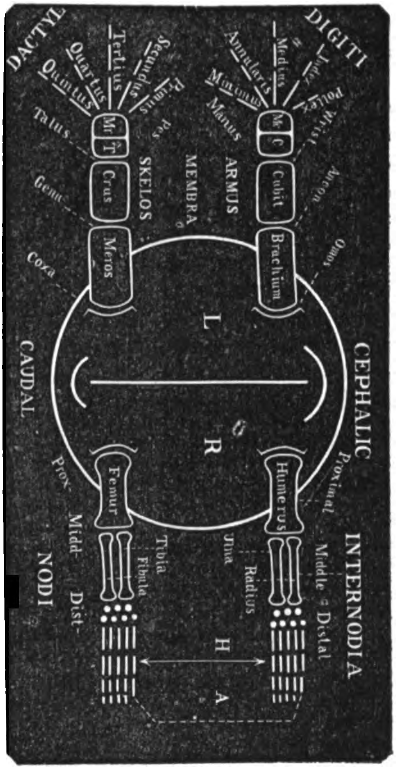
## II. NOMENCLATURE OF PARTS.

The great activity of workers in homologies demands the repair and, in some cases, the renewal, of their "tools of thought"; our anatomical nomenclature is now as incongruous and unmanageable as zoological nomenclature was before Linnæus; even our highest authorities employ those abominable terms compounded of "fore" (200, 1, 273, and 2, 281), and describe the skeleton of an ape as if in the erect attitude, so as to reverse all the terms of comparison with the vertebrate animal in its normal position (275, 176, note 2). Special inconsistencies and objectionable features will appear in the following synonymy, wherein I have purposely quoted, as far as possible, from high authorities, since upon them we must rely for effecting

[1] Since the above was written I have read such parts of 329 as discuss the relative positions of the membra; but although the author well describes the isotropy which exists in many vertebrates where the membra either project laterally, or are rotated so as to bring the ancon and genu forward, as in tortoises, and the "Heterotropie" which characterizes the membra of most other quadrupeds, no direct light is thrown upon the morphical relations between the membra themselves; perhaps his investigations upon the Torsion of the Humerus and Femur are worth consideration.

a reform. The changes proposed are, as far as possible, in accordance with the following requirements of technical terms: —

1. Classic Derivation; 2. Capacity for inflection; 3. Brevity; 4. Independence of context for signification; 5. Non-ambiguity to the ear as well as to the eye; 6. Previous use in a kindred sense. I cannot hope to have satisfied all the requirements in every case, and ask for corrections and amendments. I admit all the objections which have been urged against new terms; but am convinced that some change must be made before homology can be the exact science which it is capable of becoming; and I would refer to Agassiz (200, 3, 69), Goodsir (237, 2, 83), Owen (63, 1, XIII) and Strauss-Durckheim (331, 1, XV) in support of a correct system of nomenclature.




The accompanying diagram presents the dorsal surface of a vertebrate animal in what may be called a *neutral* or indifferent condition as to both attitude and structure; although some details are introduced for the purpose of employing this figure in other parts of the discussion. The animal is shown as a circular disk, the "germinative area," at the time it presents the two characteristic and common features of all vertebrates.

First: — A discrimination between the cephalic and the caudal regions by the formation of the cephalic and caudal hoods; and it is of great significance that, (with the Turtle at least, according to Agassiz, 200, 2, 537-539) this occurs prior to the separation into a right and a left half.

Second:— The formation of a groove, the "primitive furrow," which connects the cephalic and the caudal folds and indicates the position of the future longitudinal axis, dividing the ovum into a right and a left half.

The membra also are left in what may be considered their *neutral* position, extending outward at right angles with the longitudinal axis of the trunk and parallel with each other; that this should also be regarded as the "normal position" of the membra in contradistinction to their numerous "natural attitudes" will be shown hereafter. This neutral position of the membra presents the convexities of the knee (genu) and elbow (ancon) corresponding with the so-called "dorsal" or "extensor" or "epaxial" surfaces, the manus being supinated and placed flat upon the earth, and the whole armus having nearly the position it has in a land tortoise or in a man when upon "all fours."

The digits and dactyls are shown of nearly equal length; the premembral digit and dactyl (pollex and primus) are joined by a dotted line (A), to represent the *analogy* which they undoubtedly bear to each other; but the continuous line (H) unites the postarmal digit (minimus) with the preskeleal dactyl (primus) to indicate the *homology* which is held to exist between them by Wyman, by Coues and the writer. The carpal and tarsal bones are shown as parallel rows of similar ossicles, as suggested by Wyman (55, 274).

OMOZONE (*shoulder girdle*).

*Scutula*, Lat. —'Ωμος, (?) Gr.— *Ceinture thoracique*, Foltz, 39.— *Schulter-gürtel*, Geg., 230, *fere*.—*Shoulder-girdle*, Park., 292, *fere*.— *Scapulo-coracoid arch*, Ow., 20, 184.— *Hæmal arch of occipital vertebra*, Ow., 63, 1, 125.—*Scapular girdle*, Goods., 237, 2, 199.— *Scapular arch*, Wym., 55, 260.

REMARK. For this and the following name I am indebted to Dr. Coues.

ISCHIZONE (*pelvic girdle*).

*Pelvis*, Lat. —'Ισχία, (?) Gr.— *Ceinture pelvienne*, Foltz, 39, *fere*. —*Beckengürtel*, Geg., 230 *fere*.— *Hæmal arch of* (?) *vertebræ*, Ow., 20, 268.—*Pelvic girdle*, Hum., 72, *fere*.—*Pelvic arch*, Ow., 63, 2, 307.

MEMBRA (*the limbs*).

*Membra*, Lat.—'Ρίθεα, Gr.—*Membres, extremités*, Fr.—*Glieder*, Ger. —*Artus*, Bonnp., Tr. Linn. Soc. 18, 248.—*Legs*, vulgo.—*Limbs*, Goods.,

240, *fere.*—*Lateral limbs*, Hum., 248, 65.—*Parial limbs*, Ow., 63, 1, 62. —*Appendages*, Miv., 275, *fere.*—*Diverging appendages*, Ow., 63, 2, 581.—*Appendicular parts*, Flow., 71, 219.—*Locomotive organs*. Ow., 63, 2, 280.—*Liberated ribs*, Ok., 285, Par. 2370.—*Archipterygii*, Geg., 68, 400.—*Extremitäten paarigen*, 231, 424.

Membrum, membri, membra, membrorum, membral.[1]

### Nodus (*articulus membri*).

*Nodus articulus*, Lat.—*Ἄρθρον*, Gr.—*Joint, articulation*, Fr.—*Gelenk*, Ger.—*Joint*, Ow. 63, 2, 542, (*internodium*).[2]—*Articulation*, Anthropotomy, *fere.*

Nodus, nodi, nodi, nodorum, nodal.

### Internodium (*segmentum membri*).

*Internodium*, Lat.—*Τμῆμα*, (?) Gr.—*Internode*, Coues, 70, *fere.*—*Segment*, Ow., 63, 2, 306.—*Joint*, vulgo, (*nodus*).

Internodium, internodii, internodia, internodiorum, internodial.

### Armus[3] (*membrum anterius*).

*Brachium, ulna, lacertus*, Lat.—*Βραχίων*, Gr.—*Bras*, Fr.—*Arm*, Ger.—*Diverging appendage of occipital vertebra*, Ow., 63, 2, Table I.—*Fin*, Ow., 63, 2, 437.—*Leg, limb, member, fin, appendage*, with adjectives as follows: *Fore*, Ow., 63, 2, 482.—*Upper*, Macl., 23, 666.—*Anterior*, Hux., 42, 1.—*Pectoral*, Ow., 63, 2, 65.—*Atlantal*, Barclay (quoted by Owen, 20, 334).—*Thoracique*, Foltz, 39, *fere.*—*Sternal*, Vogt, Nature, Jan. 20, 1870.

Armus, armi, armi, armorum, armal.

### Omos (*nodus proximus armi*).

*Ὦμος*, Gr.—*Épaule*, Fr.—*Achsel*, Ger.—*Shoulder-joint, scapulo-humeral articulation*, Anthropotomy.

Omos, omou, omoi, omon, omal.

[1] Here and hereafter are given nom. and gen. singular and plural, and the adjective form of the word; the first number after an author's name corresponds to the number of his work upon the list; the last indicates the page; the second, when it occurs, the volume of the work.

[2] Here and elsewhere a word in parenthesis indicates that the preceding synonym has also been used for the part designated by that word, and thus in two distinct senses.

[3] This word means strictly rather shoulder than arm, but no other term is equally suitable, and the sound of this is in its favor.

ANCON (*nodus medius armi*).

*Cubitum*, Lat.—'Αγκών, Gr.—*Coude*, Fr.—*Elbogen*, Ger.—*Elbow*, Wym., 55, 265.—*Elbow-joint*, Anthrop.

Ancon, anconos, ancones, anconon, anconal.

CARPUS (*nodus ultimus armi*).

*Carpus*, Lat.—Καρπός, Gr.—*Carpe, poignet*, Fr.—*Handgelenk*, Ger.—*Wrist-joint*, Ow., 63, 2, 310.—*Knee*, Ag., 200, 1, 361, (*genu*). Maynard, Nat. Guide, p. 40.—*Radio-carpal articulation*, Anthrop.

STETHOS (*pseudo-internodium proximum manus.*)

*Metacarpus*, Anthropotomy.—*Stethos*, Str. Dur., 331, 1, 116.

Stethos, stethou, stethoi, stethon, stethal.

REMARK. This term was really applied by Strauss-Durckheim, not to the whole metacarpus, but to the second metacarpal bone; but upon the ground that the Greeks applied the term to the whole metacarpus.

BRACHIUM (*internodium proximum armi*).

*Lacertus*, Lat.—*Bras, or bras supérieur*, Fr.—*Oberarm*, Ger.—*Brachium*, Fl., 71, 219, (*armus*).—*Arm*, Fl., 71, 239, (*armus*).—*Upper arm*, Fl., 71, 219.—*First segment*, Ow., 63, 2, 306 (*meros*).—*Proximal segment*, Hum., 36, *fere*, (*meros*).

Brachium, brachii, brachia, brachiorum, brachial.

CUBITUM (*internodium medium armi*).

*Cubitum*, (?) Lat.—Πῆχυς, Gr.—*Avant bras*, Fr.—*Vorderarm*, Ger.—*Cubit*, Macd., 255, *fere*.—*Fore arm*, Fl., 71, 219.—*Middle segment*, Hum., 36, *fere*, (*crus*).—*Second segment*, Ow., 63, 2, 306 (*crus*).—*Antebrachium*, Fl., 71, 219.

Cubitum, cubiti, cubita, cubitorum, cubital.

MANUS (*internodium ultimum armi*).

*Manus*, Lat.—Χείρ, Gr.—*Main*, Fr.—*Hand*, Ger.—*Manus*, Fl., 71, *fere*.—*Hand*, Wym., 55, 273.—*Foot*, Ow., 63, 2, 484, (*pes*).—*Fore-foot*, Ow., 63, 2, 283.—*Fore-hand*, Ow., 63, 2, 541.—*Distal segment*, Hum., 36, *fere*, (*pes*).—*Terminal segment*, Fl., 71, 252, (*pes*).

Manus, manûs, manus, manuum, manual.

DIGITI (*digiti manus*).

*Digiti manûs*, Lat.—*Δάκτυλοι*, Gr.—*Doigts*, Fr.—*Finger*, Ger.—*Fingers and thumb*, Ow., 63, 2, 544.—*Toes*, Ow., 63, 2, 488 (*dactyli*). —*Digits*, Ow., 63, 2, 539, (*dactyli*).—*Fingers*, Ow., 63, 2, 328.

Digitus, digiti, digiti, digitorum, digital.

POLLEX (*digitus radialis*).

*Pollex*, Lat.—*'Αντίχειρ*, Gr.—*Pouce*, Fr.—*Daumen*, Ger.—*Pollex*, Fl., 71, *fere*.—*Thumb*, Wym., 55, 276.—*First digit*, Fl., 71, 255, (*primus*). —*Outer digit*, Hum., 34, 389; 326, 112.—*Inner digit*, Ow., 63, 2, 509, (*primus*).—*Radial digit*, Fl., 71, 255.—*Preaxial digit*, Fl., 71, 337. *First toe*, Goods., 237, 1, 450, (*primus*).

Pollex, pollicis, pollices, pollicum, pollical.

INDEX (*digitus a pollice proximus*).

*Digitus index vel salutaris*, Lat.—*Λίχανος*, Gr.—*Indicateur*, Fr.—*Zeigefinger*, Ger.—*Index*, Ow., 63, and Fl., 71, *fere*.—*Second digit*; Ow., 63, 2, 428, (*secundus*).—*Fore-finger*, vulgo.

Index, indicis, indices, indicum, indical.

MEDIUS (*digitus medius*).

*Digitus medius vel famosus, vel infamis, vel impudicus*, Lat.—*Doigt du milieu*, Fr.—*Mittelfinger*, Ger.—*Middle toe*, Ow., 63, 2, 456, (*tertius*).—*Middle finger*, *vulgo*.—*Medius*, Ow., 63, Fl. 71, *fere*.—*Third digit*, Wym., 55, 276, (*tertius*).—*Second digit*, Sandwith, letter to Owen, Mem. on Aye-Aye, Trans. Zool. Soc., (*index*).—*Verpus*, Str. Dur., 331, 1,117.

Medius, medii, medii, mediorum, medial.

MINIMUS (*digitus ulnaris*).

*Digitus minimus; digitulus auricularis brevissimus*, Lat.—*Doigt auriculaire*, Fr.—*Ohrfinger*, Ger.—*Little finger*, Wym. 55, 276.—*Outermost digit*, Ow., ? (*quintus*).—*Fifth digit*, Ow., 63, 2, 307 (*quintus*).—*Minimus*, Ow., 63, Fl. 71, *fere*.—*Wing-finger*, (of the Pterodactyle) Ow., 289, 273.—*Micros*, Str. Dur., 331, 1, 117.

Minimus, minimi, minimi, minimorum, minimal.

ANNULARIS (*digitus a minimo proximus*).

*Digitus annularis, medicus, medicinalis*, Lat.—*Doigt annulaire*, Fr.—*Ring finger*, Ger.—*Annularis*, Ow., 63, Fl., 71, *fere*.—*Third finger*, (Eng. Lat. Lexicon).—*Fourth digit*, Ow., 63, 2, 306 (*quartus*).—*Ring-finger*, vulgo.—*Paramèse*, Str. Dur., 331, 1, 117.

Annularis, annularis, annulares, annularium, annularial.

SKELOS (*membrum posterius*).

*Artus*, Lat.—Σκέλος, Gr.—*Jambe*, Fr.—*Schenkel*, (?), Ger.—*Diverging appendage of pelvic arch*, Ow., 63, 2, 429.— *Sacral limb*, Barclay (quoted by Ow., 20, 334. note).—*Hind limb*, Ow., 63, 1, 191.—*Lower limb*, Macl., 23, 666.—*Pelvic limb*, Macl., 23, 664.—*Membre pelvien*, Foltz, 39, *fere*.—*Membre inferieur*, Richaud, 15, *fere*.—*Leg*, vulgo, (*crus*).

Skelos, skeleos, skelea, skeleon, skeleal.

COXA (*nodus proximus skeleos*).

*Coxa*, Lat.—'Ισχιόν, Gr.—*Hanche*, Fr.—*Lende*, *Hüfte*, Ger.—*Hip joint*, vulgo.—*Innominato-femoral articulation*, Anthrop.

Coxa, coxæ, coxæ, coxarum, coxal.

GENU (*nodus medius skeleos*).

*Genu*, Lat.— Γόνυ, Gr. — *Genou*, Fr.—*Knie*, Ger.— *Knee*, Wym., 55, 265.— *Knee-joint*, vulgo. — *Femoro-tibial articulation*, Anthrop.

Genu, genûs, genua, genuum, genual.

TALUS (*nodus ultimus skeleos*).

*Talus*, Lat. — Σφυρόν, Gr. — *Coude-pied*, Fr.— *Knöchel*, Ger.— *Ankle*, vulgo.—*Ankle-joint*, vulgo.—*Tibio-tarsal articulation*, Anthrop.

Talus, tali, tali, talorum, talar.

MEROS (*internodium proximum skeleos*).

*Femur*, Lat.—Μηρός, Gr.— *Cuisse*, Fr. — *Schenkel*, Ger. —*Proximal segment*, Hum., 36, *fere* (*brachium*).—*Thigh*, Fl., 71, 281.

Meros, merou, meroi, merōn, meral.

CRUS (*internodium medium skeleos*).

*Crus*, Lat.—Κνήμη, Gr.—*Jambe*, Fr.—*Unterschenkel*, Ger.—*Middle segment*, Hum., 36, *fere*, (*cubitum*)—*Cnemion*, Ow., 63, 1, 170.—*Leg*, Fl., 71, 281, (*skelos*).

Crus, cruris, crura, crurum, crural.

PES (*internodium ultimum skeleos*).

*Pes*, Lat.— Πούς, Gr.— *Pied*, Fr.— *Füss*, Ger.— *Distal segment*, Hum., 36, *fere* (*manus*).— *Foot*, Wym., 65, 276, (*manus*).— *Hand*, Ow., 63, 2, 294.—*Hind hand*, Ow., 63, 2, 542.—*Hind foot*, Ow., 63, 2, 487.— *Pes*, Ow., Fl., Miv., Rol., *fere*.— *Terminal segment*, Fl., 71, 306.

Pes, pedis, pedes, pedum, pedal.

PODIUM (*pseudo-internodium proximum pedis*).

*Metatarsus*, Anthropotomy, *fere*.—*Podium*, Str. Dur., 331, 1, 12.

Podium, podii, podia, podiorum, podial.

REMARK. This term was not really applied by Strauss-Durckheim to the metatarsus, but the vowel variations of podion (padion, pedion, pidion, podion, pudion) were applied to the metatarsal bones of the primus, etc., respectively.

DACTYLI (*digiti pedis*).

*Digiti pedis*, Lat.— *Δάκτυλοι ποδός*, Gr.—*Doigts postérieurs*, Fr.—*Zehen*, Ger.—*Digits*, Ow., 63, *fere*, (*digiti*).—*Toes*, Ow., 63, 2, 362, (*digiti*).

Dactylus, dactyli, dactyli, dactylorum, dactylic.

PRIMUS (*dactylus tibialis pedis*).

*Allex*, Lat.— *Gros orteil*, Fr.—*Grosse Zehe*, Ger.—*Hallux*, Ow., 63, 2, 553.—*Great toe*, Ow., 63, 2. 553.—*Thumb*, Ow., 63, 2, 544, (*pollex*).—*Inner toe*, Rol., 234, 1, VIII.—*Tibial digit*, Fl., 71, 306.—*Preaxial digit*, Fl., 71, 337.—*First digit*, Fl., 71, 306.—*Hinder thumb*, Ow., 63, 2, 512.—*Tibial toe*, Ow., 63, 2, 362.—*Protos*, Wild., 67, *fere*.—*Pollex*, Hum., 34, 576.

Primus, primi, primi, primorum, primal.

SECUNDUS, (*dactylus a primo proximus*).

*Digitus secundus pedis*, Lat.—*Hellux*, Str. Dur., 331, 1, 125.—*Index*, Rol., 284, L, (*Index*).—*Second toe*, Ow., 63, 2, 553, (*Index*).—*First Hind-finger*, Tenney, Man. of Zoology, 22.—*Second digit*, Ow., 63, 2, 290, (*Index*).—*Second finger*, Van der Hoeven, 307, 743.—*Deuteros*, Wild., 67, *fere*.

Secundus, secundi, secundi, secundorum, secundal.

TERTIUS, (*dactylus medius*).

*Digitus tertius pedis*, Lat.—*Hillux*, Str. Dur., 331, 1, 125.—*Middle toe*, Ow., 63, 2, 309 (*medius*).—*Third toe*, Ow., 63, 2, 553.—*Third digit*, Ow., 63, 2, 308 (*medius*).—*Main toe*, Ow., 63, 2, 309.—*Tritos*, Wild., 67, *fere*.

Tertius, tertii, tertii, tertiorum, tertial.

QUARTUS, (*dactylus a quinto proximus*).

*Digitus quartus pedis*, Lat.—*Hollux*, Str. Dur., 331, 1, 125.—*Outer toe*, (with Birds) Ow., 63, 2, 83, (*quintus*).—*Fourth toe*, Ow., 63, 2, 309.—*Fourth digit*, Ow., 63, 2, 308.—*Tetratos*, Wild., 67, *fere*.

Quartus, quarti, quarti, quartorum, quartal.

QUINTUS (*dactylus fibularis*).

*Digitus quintus pedis*, Lat.—*Hallux*, Str. Dur., 331, 1, 125.—*Fifth digit*, Ow., 63, 2, 309, (*minimus*).—*Fifth toe*, Ow., 63, 2,309.—*Little toe*, *vulgo*.—*Outer toe*, Wym., 55, 277.—*Pemptos*, Wild., 67, *fere*.

Quintus. quinti, quinti, quintorum, quintal.

There remain for consideration the terms used to designate the following internodia; in the *armus*, the *carpus*, the *metacarpus*, and the *phalanges*; in the *skelos*, the *tarsus*, the *metatarsus*, and the *phalanges*; also the nodi which separate them and which are called carpo-metacarpal, metacarpo-phalangeal (or knuckle) and inter-phalangeal articulations of the armus, and tarso-metatarsal, metatarso-phalangeal and inter-phalangeal articulations of the skelos; there are obvious objections to all these terms, chiefly on the score of length, and the shorter terms of Hippotomy (cannon-bone, great and little pastern, and coffin-bone, etc.), are not available for our purpose. I am not prepared to suggest the technical terms which are needed, excepting in the case of the phalanges or digital and dactylic internodes. These are variously termed proximal, middle and distal, or first, second and third (proximal phalanx of the index, etc.), but all these terms are objectionable as to length, and the latter in that they do not indicate whether *first* is counted from the proximal or the distal extremity of the digit or dactyl. I would therefore suggest that the terminal phalanx of a digit or dactyl be called $\alpha$ (alpha), the middle one, $\beta$ (beta), and the proximal, $\gamma$ (gamma); the corresponding metacarpal bone may be called delta ($\Delta$).[1] For the present, however, the above nomenclature should be employed *only when there are three* phalanges in the digit or dactyl; for when the number is less, we are not yet sure which is the missing one;[2] and when there are more, as with Cetacea, the homologous phalanges are undetermined.

To show what a reduction of labor and space is gained together with the greater definiteness, instead of saying that the Extensor indicis (of man) is inserted into the third phalanx of the fore-finger, we may now say that it is inserted into "$\alpha$ indicis."

There seems to be an ideal, if not a real, difference between the above mentioned segments of the manus and pes and those three primary segments which have been generally recognized; the same may be said of the articulations between these segments. And although upon strict anatomical grounds we must designate them also as "internodia"

[1] This is less complex and artificial than the nomenclature of the metacarpals and metatarsals proposed by Strauss-Durckheim, 331, 1, 116 and 124.

[2] This problem will be discussed hereafter.

and "nodi," yet for morphological purposes, we may indicate their nature as subdivisions of primary segments by calling them "pseudo-internodia" and "pseudo-nodi."[1]

### III. NOMENCLATURE OF IDEAS.

During the early part of the present century all kinds and degrees of relationship between organisms and parts of organisms, were expressed by the single term *Analogy*, or by phrases which were even more indefinite; Swainson used the expression "immediate and remote analogy,"[2] but the distinction between these two relations was not at that time fully recognized even by the authors who have since done so much toward making it clear;[3] since 1846, however, these relationships have been generally admitted to be of two kinds, *homology*, or *affinity*, or *internal* or *structural resemblance* and *analogy* or *external* or *functional resemblance.*[4]

These two kinds of organic relationship have seemed to be the result of the operation of laws or principles, which, whether regarded as of material or divine origin, may be not irreverently called the two great commandments of Nature; the first is variously termed, the principle of *adherence to plan*, *type*, *pattern*, *or idea*; the second is called *adaptation to ends*, *to special uses*, *to final causes*, *etc.*; and by degrees the second has come to be included under the single term Teleology; the first under the less appropriate term Morphology; so that, speaking in the most general way, organisms which are *morphologically* or, for short, *morphically similar*, are *homologous*, and those which are *teleologically* or *telically similar*, are *analogous.*

But it is evident that each of these general terms includes several special kinds and degrees of relationship, and that these cannot all be equally manifested in the same organs, or attributes of organs; we should therefore endeavor to ascertain the respective criteria by which these degrees of relationship may be recognized. In short there remains to be done for Comparative Anatomy the kind of work which Agassiz has begun for Zoölogy; and we must aim to discover the morphic or taxonomic *values* of organs and systems of organs,

[1] A distinction between morphological and teleological joints was proposed by me in 45, 28, with respect to the radio-ulnar articulation; and this has been accepted by Coues, 70, 370.

[2] Cuvier; Anat. Comp.; t. VII, p. 164.

[3] Agassiz; Proc. Zool. Soc., 1834, p. 120; Owen; P. 1, s. 1830, p. 28; 1833, pp. 12, 109, 145, 146; 1842, pp. 86, note, and 143.

[4] Strickland, 343, Owen, 20, Agassiz, 325.

whether central or peripheral; of organisms which are low or high, ancient or recent, immature or adult; and of their various attributes, such as relative position, mode of development, chemical composition, size, form and color.

The following diagram (p. 179) is an attempt to indicate in concise form the work that has to be done in order to reduce our present confused notions of zoölogical and anatomical relationship to something like a logical coördination; it is essentially similar to one which was presented three years ago, 58, Lect. 1, and I have not attempted to incorporate in it the new and valuable ideas of Lankester, 257, and Mivart, 278. I am not now ready to state my grounds of difference from some of their views; and will merely express my gratification at this sign of the recognition of what is to be done, by the new and vigorous school of English anatomy.

For analogy and the categories thereof, see Agassiz, 201, chap. 2, sect. IX, 203, and the chapter on Morphology and Nomenclature, 200, 8, chap. 2, sect. IV. I shall confine myself to the discussion of homologies.

### Plural or Relative Homology.

This is the relation between corresponding parts of *different* individuals; Geoffroy proposed to retain the term "analogie" for this relation and to employ "homologie" only for what is here named single or absolute homology; but the two terms were used indiscriminately until 1846, when Owen, 20, 175, proposed the name "special homology" for this relation, and "serial homology" for the other. Of course the correspondence between the zoölogical criteria of Agassiz, 201, 261 and 272, and the anatomical criteria, is provisional until the relative value of these criteria themselves is fully ascertained; but it appears to me that some good may follow their simultaneous presentation upon a diagram, even if it lead merely to a more general admission of the principle of subordination of characters.

I also venture to suggest that since the three higher groups are based upon *internal* structural features and the three lower groups upon *external* features, and since both *plan of structure* and *relative position* of organs, which are *branch* characters, and *outline* as determined by structure, and *relative size* of organs, which are family characters, are all alike displayed upon a transverse (vertico-lateral) section of the whole body, we may hereafter be able to say how the other two sections, (latero-longal and vertico-longal) correspond with the criteria of the class and genus, the order and species, respectively Some other questions in this connection will be discussed hereafter.

## TABLE OF THE SUB-DIVISIONS OF HOMOLOGY.[1]

### PLURAL OR RELATIVE HOMOLOGY.

| Zoölogical criteria.[2] | | Anatomical criteria. | Characteristic section. | Kind of homology. | Examples: organs of |
|---|---|---|---|---|---|
| Plan of structure. | Internal. | Relative position. | Vertico-lateral. | Branch. | Dog and Bird |
| Mode of execution. | | Histological composition[3] | Latero-longal? | Class. | " " Bat |
| Complication of structure. | | Chemical composition.[3] | Vertico-longal? | Ordinal. | " " Cat |
| Form determined by structure. | External. | Relative size, natural attitude. | Vertico-lateral. | Family. | " " Lycaon |
| Ultimate structure. | | Numerical composition. | Latero-longal? | Generic. | " " Wolf |
| Size, ornamentation, habit, etc. | | Size, color, etc. | Vertico-longal? | Specific. | " " Dog |

### SINGLE, ABSOLUTE OR TROPICAL HOMOLOGY.

| | Criteria. | Planes. | Kind of Homology. | Examples. |
|---|---|---|---|---|
| Serial homology or Syntropy. | Morphical parallelism on *same* side of planes. | Vertico-lateral. | Mekesyntropy. | Two thoracic ribs. |
| | | Vertico-longal. | Platesyntropy. | Brachium and cubitum. |
| | | Latero-longal. | Hypesyntropy. | A rib and its cartilage. |
| | do. with *telical* antagonism. | | Pseudantitropy. | Dorsal and ventral arches. |
| Polar homology, or Antitropy. | Morphical antagonism on *opposite* sides of planes. | Latero-longal. | Hypetropy. | Male and female mammæ. |
| | | Vertico-longal. | Platetropy. | Right and left manus. |
| | | Vertico-lateral. | Meketropy. | Armus and skelos. |

[1] For spherical homology, see the text, p. 180.
[2] According to Agassiz, 200 and 201, Chap. 2, Lect. vii.
[3] I am in doubt respecting the relative value of these attributes, and even whether some other should not be substituted for one or both of them. The mode of yolk segmentation should perhaps have place here, but that it is not a branch character; see Agassiz, 800 and 101, Chap. 8, Lect. 1. See the text for full admission of the provisional nature of this table.

### Single or Absolute or Tropical Homology.

Although the detailed comparison of the membra with each other was first made by Vicq d'Azyr, yet the germ of tropical homology existed in all recognitions of the correspondence of the right and left sides of the body; many and vague terms were employed (parallelism, analogy, homology, correspondence, repetition) which did not imply a difference between single and plural homology, or between the different kinds of the former. I hope hereafter to show that the same methods of comparison and argument are as applicable to single as to plural homology; and that cephalo-caudal repetition is comparable to dextro-sinistral repetition.

### Spherical Homology.

*Radiality*, Ag., (Rem. on) 298, 279.—*Radiation*, Ag., 201, 292.—*Radial arrangement*, Rol., 294, CXLIII, CLVI.—*Radial symmetry*, Hux., 251, 46.—*Radiate symmetry*, Ag., 202, 38.—*Radial homology*, Miv., 278, 119.—*Spherical homology*, Wild., 58, Lect. 1.

Definition. The tropical relation between the morphically identical, converging spheromeres of a radiate animal.

Remark. The above definition is chiefly based upon the presentation of the subject by Agassiz especially in 200, 3, pp. 79, 260, 261, etc.; but there remains much to be done toward clearing up the confusion in which the whole subject now rests. In the first place two distinct ideas are included in the above list of terms; radiality is a general name for an *abstract idea* involving the plan of structure of a branch of the animal kingdom; Agassiz admits, 200, 3, 209, 210, 211, that upon this essential plan of radiality may be superinduced an apparent bilateral symmetry, but that he does not regard this as constituting a true bilaterality is shown by his contrasting the Radiates with bilateral animals, 200, 3, 260.[1]

But the very existence of such a radiate idea, is questioned by Morse, 281, 163, Clark, 211, 128, Huxley, 251, 47, and Rolleston, 294, CXLIII, who hold that the bilateral symmetry which is quite prominent in the larvæ of echinoderms is equally, if not more characteristic of the branch; some join the echinoderms with the worms, Rolleston, 294, 152, note; indeed so widely do they differ from Agassiz in respect to the classification of the invertebrates, that anything like

[1] Also by his remarks in the Report of the Trustees of the Mus. of Comp. Zool. 1868, p. 9.

a compromise upon a ground between the two extremes seems quite impossible.

I do not pretend to offer an opinion here, but have not yet seen reason for denying the existence of the radiate idea, and would refer to 45, 14, for suggestions as to a distinction between the morphical term "radiality" and the telical term, "radiation."

Agassiz evidently includes within the abstract idea of radiality, the existence of a real homology between the several spheromeres; but it is not clear whether the term "radiate" or "radial symmetry" means that each spheromere is symmetrical in itself as is believed by Pittard, 293, 850, or with its immediate neighbor, or "antitropically," as implied by Agassiz, 200, 3, 260; in short, when any two contiguous spheromeres are compared, do the inner and outer surfaces correspond together, as with two eyes, or does the inner surface of one correspond with the outer surface of the other, as with two successive thoracic ribs? is the homology antitropical or syntropical or only general?

### Syntropy.

*Serial homology*, Ow., 20, 176; 63, 1, XIII.—*Symmetry*, Ow., Proc. Zool. Soc., 1831, p. 67.—*Homology*, Gervais, (?).—*Unreversed serial repetition*, Pitt., 293, 845.—*Homotypy*, Ow., 63, 2, 361.—*Irrelative repetition*, Ow., 63, 1, XIII.—*Reihenfolge oder Nachfolge*, Pagens., 54, 162.—*Serial symmetry*, Miv., 277, 292.—*Serial actinology*, Miv., 278, 120.—*Homoplastic serial homology*, Miv., 278, 119.—*Homogenetic serial homology*, Miv., 278, 119.—*Similar parallel repetition*, Coues, 70, 149.[1]

Syntropy, syntrope, syntropous, syntropic or syntropical.[2]

Definition. The morphotropic relation between parts upon the same side of a structural plane.

Example. See Mekesyntropy, Platesyntropy and Hypsesyntropy.

### Mekesyntropy or Syntropy (μῆκος, length, and syntropy).

*Irrelative or vegetative repetition*, Ow., 20, 176, (1846), 63, XIII, (1866).—*Unreversed serial repetition*, Pitt., 293, 845, (1850).—*Serial homology*, Ow., 63, 1, XII (1866).—*Longiserial homology*, Wild., 58, Lect. 1, 1867.—*Homogenetic serial homology*, Miv., 278, 119 (1870).

[1] With few exceptions, the synonyms for the names of ideas are given in chronological order.

[2] The other terms may be similarly inflected.

DEFINITION. The syntropical relation between parts upon the same side of the vertico-lateral plane.

EXAMPLE. Two thoracic ribs or vertebræ.

REMARK. Since this is the kind of syntropy which is most apparent and most commonly treated of, it may be allowable to use the shorter term syntropy for the longer one when no misunderstanding can arise.

### PLATESYNTROPY (πλάτος, breadth).

*Actinology* (*serial*, *correlated*, *etc.*), Miv., 278, 118.—*Latiserial homology*, Wild., 58, Lect. 1.

DEFINITION. The morphotropical relation between parts upon the same side of the vertico-longal plane.

EXAMPLES. Brachium and cubitum; two right maxillary teeth; two dermal scuta of right side of armadillo.

### HYPSESYNTROPY (ὕψος, height).

*Vertiserial homology*, Wild., 58, Lect. 1.
(Other synonyms will be included under Pseudantitropy).

DEFINITION. The syntropical relation between parts upon one side of the longo-lateral plane, which, in vertebrates at least, I am inclined to believe should not bisect the body of a single individual into a dorsal and a ventral region, but should pass between *two individuals of opposite sexes*.

EXAMPLES. A rib and its cartilage; two muscular bundles of the same muscular segment (myocomma, Owen; myotome, Good sir).

REMARK. Probably no objection exists to giving the name proposed to the relation between a rib and its cartilage; for both lie ventrad of the vertebral axis; but so general is the impression that the vertebrate body presents a "dorso-ventral symmetry" (Macl., 23, 671; Pittard, 293, 851; Wyman, 55, 253; Spencer, 299, 2, 186; Coues, 70, 150), that it is not easy to show that this relation between organs lying upon *opposite* sides of the vertebral axis is really one of syntropy rather than of antitropy; yet I am convinced that this "symmetry" which is so striking in some fishes, is one of appearance chiefly and affects the external form only; certain it is that nothing

like a real homology has ever been shown to exist between the internal organs of the dorsal and ventral regions; and the development of the ovum results in a differentiation of dorsal from ventral, which is not suggestive of any such homologous relation as is so apparent between right and left, or between cephalic and cercal, regions.

This important question will be hereafter indicated as one of the problems to be solved. At present, I will only state my conviction that the complete vertebrate *animal* consists of two *individuals* of different sexes, placed face to face;[1] there then results a true antitropical homology in all three directions corresponding with the three diameters of a solid; a lateral homology or "platetropy" between two right and left halves of this compound individual, a longal homology or "meketropy" between its cephalic and cercal regions, and a vertical homology or "hypsetropy" between the dorsal regions of the two individuals and between the ventral regions in like manner, as in fig. 2. Such a homology of three directions might be exemplified in a perfect double monster by "anterior duplicity," described and figured as "Zipophage" by St. Hilaire, 235, Pl. XIV, fig. 3.[2]

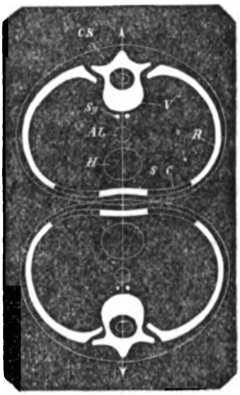


Fig. 2.

### PSEUDANTITROPY.

*Polar relation of back and belly*, Oken, 285, Par. 2093, (1810).—*Dorso-ventral symmetry*, Macl., 22, 667, (1849).—*Antero-posterior symmetry*, Pitt., 293, 851, (1850).—*Tergality* (in part), Ag., (Rem. on) 298, 279, (1861).—*Dorso-ventral polarity*, Dana, 218, 351, (1863).—*Verticality* (in part), Wild., 45, 14, (1865).—*Bipolarity*, Clark, 211, 265, (1865).—*Vertipolar homology* (in part), Wild., 58, Lect. 1, (1867).—*Vertical homology*, Miv., 278, 120, (1870).—*Dorso-abdominal*

[1] Prior suggestions of this idea are contained in Par., 2955 of 285: but indeed, there are few morphological ideas of the present day, germs of which cannot be found in the extraordinary work here cited; and although it is not altogether satisfactory to find one's most valued conceptions thus ambiguously anticipated, no worker in homology should try to lessen Oken's just fame, or hold any other than the opinion which one of his greatest pupils has given us concerning his work. Agassiz, 200, and 201, chap. III, Sect. V.

[2] This would be a *Dicephalus tetrabrachius tetrapus*, in the nomenclature of Fisher, 229, 61.

*symmetry*, Coues, 70, 150, (1870).—*Supero-inferior symmetry*, Coues, 70, 150, (1870.)— *Correlated serial secondary actinology*, Miv., 278, 120, (1870).— *Vertical symmetry*, Miv., 279, 165, (1871).—*Intrinsic bilateral symmetry* (of membra), Fols., 40, (?),[1] (1864).—*Antitropy*, (?) (with Radiates), Ag., 200, 3, 260.

DEFINITION. The *apparently antitropic* relation between parts which are *telically opposed* to each other, but lie upon the *same* side of a structural plane.

EXAMPLES. Of *vertical pseudantitropy*, the dorsal and hæmal arches and the dorsal and anal fins; of *longitudinal pseudantitropy*, corresponding maxillary and mandibular teeth; the anterior and posteror ends of the sternum in many quadrupeds; the prearmal and postarmal borders of manus (as of *Chelydra serpentina*, Flow., 71, 253); of *lateral pseudantitropy*, the inner and outer canthi of the eye; the opposite sides of an apparently bilateral radiate, (Ag., 200, 3, woodcuts 88–91).

REMARK. The question involved here has been indicated under hypsesyntropy and spherical homology. No doubt it will appear to many that it is a question of words rather than of facts; but until I am convinced that *ideas* are not embodied in material forms, I shall aim to at least show what confusion we are now in respecting the nomenclature of both the ideas and the forms.

### ANTITROPY.

*Homologie symmetriqué*, Foltz, 39, 51, (1863).—*Symmetrie*, Flour., 228, *fere*, (1844). —*Duplicity*, Ok., 285, Par. 78, (1810).—*Polarity*, Ok., 285, Par. 76.(1810).—*Antitropy* (?), Schimper and Braun, (?).—*Symmetry*, Ok., 285, Par. 2096, (1810).—*Respective symmetry*, Architecture.—*Antitropic relation*, (?), Ag., 200, 3, 260, (1860).—*Laterality*, Ag., (Rem. on), 298, 279, (1861).— *Anatomical symmetry*, Fols., 40 (?), (1864).—*Antitypy*, Wild., 45, 15, (1865).—*Polar homology*, Wild., 45, 14, (1865).— *Opposition oder Spiegelwilde*, Pagens., 54, 162, (1867).— *Polar antitypy*, Coues, 70, 372, (1870).— *Reversed repetition*,[2] Coues, 70, 152, (1870).—*General antagonism*, ib., 193.—*Antitypical correlation*, ib., 222.—*Repetitive homology*, ib., 398.—*Opposite reversed repetition*, ib., 149.—*Symmetrical repetition*, ib., 149.—*True symmetrical antagonism*, ib., 149.

[1] Here, as generally elsewhere, when an interrogation point stands for the number of the page, it is because I have only manuscript copies of the papers referred to.

[2] These are rather definitions than real synonyms.

**DEFINITION.** The morphotropic relation between parts upon opposite sides of structural planes.

**EXAMPLE.** See *hypsetropy*, *meketropy* and *platetropy*.

No better evidence of the need for a uniform and simple terminology of ideas could be asked, than is given by the above synonomy; but it will be observed that the third and fourth terms mean something more than the rest; it is difficult to say just what Oken meant by *duplicity* and indeed many of the great physiophilosopher's expressions are beyond strict logical interpretation, although it is evident that he inewardly perceived much more than he was able to express in definite terms; his Physiophilosophy was written in a kind of inspiration, (as he admits in the preface to the English translation), and inspiration is only suggestive in science, never conclusive; his term *polarity* too is used in many different senses, and Wyman has well said, 55, 257, that "it does not appear precisely what he meant by the word 'pole.'"

At any rate polarity (and perhaps duplicity) is the name for a general law of organization which is analogous to the physical polar force, Wyman, 55, 254; the result of its undisturbed action would be an absolute symmetry; the one is a *cause*, the other the effect of its *action*; and all the other terms given in our list are synonyms of symmetry, and not of polarity; I do not propose a name for the force for it is not yet understood; but I would urge that symmetry is ineligible as a technical term on account of its common use in several other senses; of all the other terms antitropy seems to express most clearly the idea we wish to convey, a respective symmetry of structure and not necessarily of external form; for this latter is early and most extensively modified by the telical antagonist of our hypothetical "polar force," the so-called "vital force." See Wyman, 55, 258.

But while antitropy seems best adapted for our purpose, it is not quite clear that those who have already employed it have meant to convey the precise idea which we have under consideration; I have not been able to obtain the works of Schimper and Braun, but I judge that they used antitropy to designate any antagonistic relation between parts of the plant embryo, and between opposite leaves upon the stem, although I am not sure that they always included an idea of real homology in this antagonism of position; Agassiz has used the term antitropy to express the relation between spheromeres upon opposite sides of a radiate, 200, 3, 260; and here, of course, the general

homology is perfect, but as he discriminates between the radiates and the bilateral animals of the other branches, it would seem better to call this relation of opposite spheromeres, simply *symmetry*, or perhaps *pseudantitropy*, and to confine antitropy to the three higher branches; for otherwise, we should have to devise another and different term for the relation in them; laterality does not seem quite suitable, because, as used by Agassiz, (Rem. on 278, 279), "it relates to the disposition of organs upon *any two sides* of the body, without reference to symmetry"; and it is not evident that the idea of real homology is included in this laterality.

### PLATETROPY.

*Symmetrie*, Fr.—*Symmetrie*, Ger.—*Symmetria*, Lat.—*Symmetry*, (in part), Most authors.—*Respective symmetry*, Architecture.—*Lateral symmetry*, Ok., 285, Par. 2114, (1810).—*Bilateral symmetry*, Ag., (Rem. on) 298, (1861).—*Homologie symetrique laterale*, Foltz, 39, 51, (1863).—*Bilaterality*, Clark, 211, 265, (1865).—*Latitypy*, Wild., 45, 14, (1865).—*Right and left symmetry*, Wy., 55, 254, (1867).—*Latipolar homology*, Wild., 58, Lect. 1, (1867).—*Lateral homology*, Miv., 278, 119, (1870).—*Lateritypy*, Coues, 70, 151, (1870).—*Transverse symmetrical repetition*, Coues, 70, 150, (1870).—*Transverse polar antagonism*, Coues, 70, 150, (1870).—*Latitropy*, Wild., 74, *fere*, (1871).

DEFINITION. The antitropical relation between parts upon opposite sides of the longo-vertical plane.

EXAMPLE. The relation between the right and left ear, nostril or kidney.

REMARK. This kind of symmetry is so evident with the majority of vertebrates and articulates, and with many mollusks and apparently with some radiates, that it is generally recognized and even thought to be absolute in some cases. But the perfect symmetry of crystals is never realized, according to high authorities, and Wyman, 55, 247, says "it may be doubted whether absolute symmetry exists anywhere." In 312, I have given instances of deviations from symmetry from many groups of animals, and have thus tried to bridge over from one side the gulf which is generally supposed to wholly separate lateral symmetry (platetropy) from longal symmetry (meketropy); the corresponding work from the other side will consist in the presentation of evidence of the close homology which, in many cases, exists between parts at the two ends of the body; and the first

step toward this is to recognize that *morphically*, as shown upon the diagram, these two regions are to each other, as are the right and left sides.

### Hypsetropy.

*Sexual homology*, Wild., 58, Lect. 1.—*Dual homology*, Wild., 58, Lect. 1.

Definition. The antitropical relation between parts of the two sexes, when facing each other.

Example. The male and female mammary glands; sterna, etc.

Remark. This kind of homology often but not necessarily includes the idea of inserted development; the difference between it and the apparent dorso-abdominal homology within a single individual has been already indicated, [p. 183].

### Meketropy.

*Symmetry in length*, Ok., 285, 2114.—*Anterior and posterior symmetry*, Wy., 35, 317.—*Fore and hind symmetry*, Wy., 49, 176.—*Antero-posterior symmetry*, Wy., 55, 277.—*Fore and aft polarity*, Dana, 218, 351.—*Antero-posterior polarity*, Dana, 218, 351.—*Cephality*, (?), Ag., (Rem. on), 298.—*Longitudinal homology*, Wild., 45, 14.—*Longitypy*, Wild., 45, 15.—*Anterior and posterior repetition*, Wild., 45, 17.—*Longitudinal polarity*, Wild., 50, 194.—*Longitudinal symmetry*, Coues, 70, 149.—*Longitudinal antitypy*, Coues, 70, 151.—*Symmetry at opposite ends*, Ogilvie, 283, 156.—*Longitropy*, Wild., 74, *fere*.—*Symmetry of superior and inferior regions*, Gerdy, 9, (?).—*Homologie symmétrique du meme côté*, Foltz, 39, 420.—*Homotypy* (*implied in homotype*), Wy., 55, *fere*.

Definition. The morphotropical relation between parts upon opposite sides of a vertical lateral plane.

Example. The cephalic and caudal regions of an embryo; the armus and skelos; a double-ended ferry-boat offers a familiar example of meketropy.

Remark. Vague suggestions of a polar or symmetrical relation between the anterior and posterior regions of the vertebrate body are contained in the writings of Oken. "The idea underlying his statement that the two ends of the body do repeat each other, is we believe, correct;" Wyman, 55, 257. Duges (Traité de Phys. Comp.

2, 204), seems to have noted the antagonistic relation of the ancon and genu and Humphrey, 36, 14, admitted a functional antagonism of the proximal parts of the membra; Gerdy, 9, (?), had already taken an artistic view of the symmetrical relation of the two ends of the body which he called "superior" and "inferior," which, like Humphrey, he traced in the proximal parts of the membra. Agassiz probably included under the term cephality an idea of homology, but it is not distinctly expressed by him or by Dana; and the idea of a symmetrical homology between parts at the two poles of a longitudinal axis has been evolved into something like clearness by Wyman and his pupils. All the arguments in favor of the generic term antitropy apply with even greater force to the specific term meketropy, for otherwise a compound term would be required.[1]

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## Section of Microscopy. April 12, 1871.

Mr. E. Bicknell in the chair. Eight members present.

Mr. R. C. Greenleaf stated that he had hastily examined some soundings made by Lieut. Brook, between San Francisco and the Hawaiian Islands. In samples from a depth of 3,300 fathoms, he had found in abundance a peculiar form which he had not yet been able to identify. In 2,500 fathoms *Triceratium spinosum* and *Eunodia gibba* Bailey, were found. Many beautiful Polycistina occurred in soundings in 2,600 fathoms. Mr. Greenleaf promised an extended report on these soundings at a future meeting.

Mr. C. Stodder made some remarks on the nature of the Podura scale, so called, which strictly belongs to a species of *Lepidocyrtus*.

For thirty years it has been considered the best test object for the microscope. About a year ago Dr. Royston Pigott published a paper, in which he declared that the so called exclamation marks were illusions, and gave reasons for believing that this appearance is caused by two rows of par-

[1] To be concluded.

allel striæ crossing each other at an angle. This paper excited much discussion among Microscopists, and the majority of students now hold that these exclamation marks are probably illusive, while the true structure of the scale is still doubtful. Mr. Stodder believed that these markings, whatever their nature, are confined to one surface of the scale.

Photographs of the scales above mentioned, as well as of *Amphipleura pellucida* and *Surrirella gemma*, taken and presented by Dr. J. J. Woodward, were exhibited.

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Wednesday, April 19, 1871.

Mr. Wm. H. Niles in the chair. Thirty-three persons present.

Mr. F. W. Putnam made a verbal communication on the classification of fishes, suggested by considerations on the discovery of the so called *Ceratodus*, in Australia.

Mr. Edwin Bicknell, of the Museum of Comparative Zoology, said, a few months since, Prof. Agassiz handed him a fossil tooth of the *Ceratodus* to have sections made from it. On making the sections and submitting them to the microscope, he had found the structure to correspond very closely with such teeth of sharks as he had examined, and he considered any one to be perfectly warranted in referring the fossil tooth to the shark family, although subsequent discovery of the living fish shows it not to belong to it. Prof. Agassiz has teeth of the recent fish, which will be subjected to examination hereafter.

Mr. Bicknell said he considered it unsafe to found genera, or even species, upon the microscopical structure of a single tooth or bone, although it has proved correct in many cases. Prof. Owen founded a genus of extinct reptiles (*Labyrinthodon*) upon the structure of some fossil teeth. Prof. Jeffries

Wyman had found the same structure in the teeth of a recent fish, the *Lepidosteus* (Gar pike of the Western rivers), but not quite so complicated in arrangement.

Mr. L. S. Burbank, of Lowell, who was present by invitation, gave the following views on the Eozoonal limestones of eastern Massachusetts:—

The observations, the results of which are here presented, relate chiefly to those deposits of crystalline limestone, that occur in the band of granitic gneiss which extends in a south-westerly direction from near the mouth of the Merrimack River through the entire breadth of the State.

To this formation belong the so-called granites of Westford and Chelmsford, which are extensively quarried for building purposes. In many other places also the gneiss of this series is highly crystalline and not readily distinguished by its mineralogical character from a true granite.

This belt of gneiss is bounded on the northwest by the slates of the Merrimack and Nashua vallies, which apparently rest conformably upon it. Moreover, there appears to be a gradual transition in passing westward, from the coarsely crystalline gneiss, through mica and hornblende schists, to the thin bedded clay slates like the roofing slate of Lancaster. It may also be observed, especially in the vicinity of Lowell and Chelmsford, that the coarser granitoid gneiss occurs in beds alternating with the thin bedded and fine grained mica and hornblende slates; while these latter pass by insensible gradations into a clay state.

From a series of careful observations on these rocks, I am convinced that the slates above referred to cannot be separated from the underlying gneiss, but *form with it a continuous series;* the whole apparently underlying the great gneissic formation that stretches across the State from north to south, through the central and western part of Worcester County, and which includes the rocks of Wachusett mountain and the adjacent highlands.

Soon after the discovery of *Eozoon Canadense* by Mr. Bicknell, in the serpentine limestone of Newbury, it was also identified by Dr. Dawson in specimens collected by me at Chelmsford; as noticed by Dr. Hunt in the *American Journal of Science* for January, 1870. The specimens then examined were not from the rock in place, but were obtained from some outlying masses near one of the quarries.

These discoveries led me to undertake a more careful examination of other limestone deposits included in the same formation ; and in May, 1870, I devoted several days to a more thorough exploration of some of the old limestone quarries, including the well known mineral localities of Bolton and Boxboro'.

These examinations resulted in the discovery of the eozoonal rock at all the quarries visited; though it appeared in the greatest abundance at Bolton and Chelmsford.

Specimens of the rock from Bolton and Boxboro' were carefully examined by Mr. Bicknell of the Museum of Comp. Zoology; and the radiating and branching tubuli, like those of the Chelmsford specimens, were clearly identified by him.

The eozoonal rock was also found in place at several of the quarries, and its position in relation to the other rocks observed. At all the quarries that I have visited, the limestone has been so thoroughly worked out that the limits of its extent at the surface can be readily traced. So completely are some of the quarries exhausted that it is now hardly possible to obtain specimens of the rock that constituted the mass of the deposits. The relation of the limestone to the enclosing rocks can thus be readily seen.

By the careful study of these relations, as observed at the time above referred to, and by reference to specimens collected and facts observed during many previous visits to some of the quarries, the conclusions have been reached which are here presented.

1. *These limestones are not true stratified rocks laid down with the gneiss, but are subsequent deposits of a vein-like character.* The fact that some of these deposits appear to be interstratified with the gneiss, and also are found along a line apparently coinciding with the strike of the strata, may seem to indicate that they are parts of original strata included in the gneiss; but their position may also be explained in accordance with another theory, in support of which I shall offer some evidence.

2. *The principal deposits occur along the line of an anticlinal, filling cavities produced by the folding and the falling down of portions of the included strata of the gneiss.* The anticlinal position is most clearly shown at Chelmsford, where there are four veins or masses of the limestone, in two lines coinciding with the strike of the gneiss.

These lines are about half a mile apart, extending in a N. E. and S. W. direction; the strike, as observed by the compass, being N. 65° E. The strata of the gneiss dip in opposite directions from these

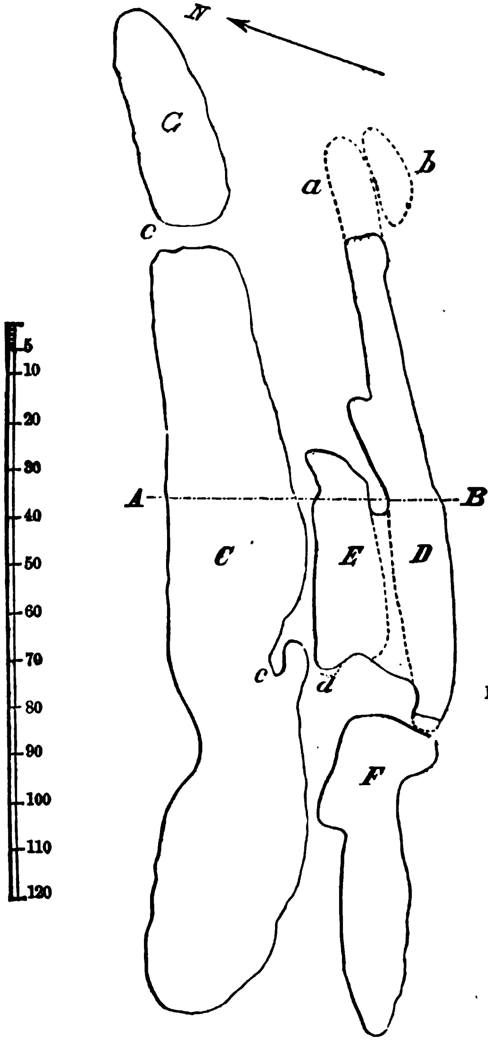


Fig. 1.

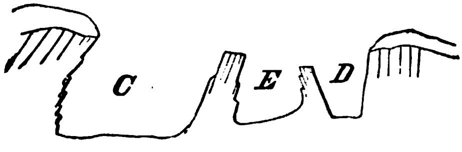


Fig. 2.

PLATE I.

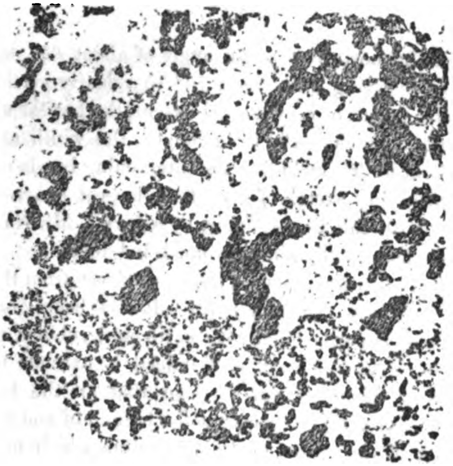

**Fig. 1.**

**Fig. 2.**

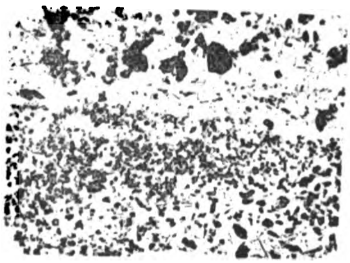

**Fig. 3.**

**Fig. 4.**

PLATE II.

lines; toward the northwest at an angle of about 65°, to the southeast at an angle varying from about 70° to a nearly vertical position.

The deposits are all of very limited extent, the largest appearing at the surface, not more than 220 ft. in length, the width at the widest part being about 60 ft., including the intervening bands of gneiss.

The accompanying sketch of one of the largest quarries was made from a survey with the Plane Table, by a friend, Mr. Nathaniel Hill of Lowell, to whose kindly aid I am much indebted.

This quarry is situated about a mile southwest from the village of Chelmsford, near the Littleton road. It has been abandoned for many years, and is partly filled with earth and rubbish so that very little limestone is now accessible, if indeed it extends to any great depth. In some places it can be seen that all the limestone has been removed, exposing the gneiss at the bottom of the excavations.

The folding of the strata, enclosing cavities which held the limestone can here be plainly seen.

In the sketch, Pl. I, Fig. 1, the unbroken lines show the walls of the cavities opening to the surface, from which the limestone has been removed. The space enclosed by the dotted lines at (*a*) represents one of the cavities which is completely arched over by the gneiss, forming a cavern about twenty feet in length.

At (*b*) is a lateral cavity or pocket, connected with the larger cavern by a small opening through a thin stratum of the gneiss. At the opposite extremity of this part of the quarry, the gneiss of the walls is also curved and folded over the limestone.

At (*c*) a projecting mass of the gneiss partly enclosed a pocket of limestone.

At the excavations marked (*E*) and (*F*) the limestone apparently extended to only a few feet in depth. The cavities in which it occurs were evidently produced by the dislocation of a portion of the gneiss of the central fold. This dislocation appears to be of a very small extent vertically, the greatest depth to which the limestone extended being not more than ten or twelve feet from the surface. At the extremity of the central excavation (*E*), at the point shown by the dotted lines at (*d*), a small cavern from which the limestone has been nearly all removed is completely covered by the folding of a layer of the gneiss, which also forms a portion of the thin partition that separates this small excavation from the larger one at (*C*).

Professor W. H. Niles, (who has visited these quarries with me, and whose careful observations will, I think, confirm my views,) pointed out

the fact here that the mass of gneiss, the dislocation of which evidently formed this little cavern, may still be seen, resting against the dividing wall a few feet below; where it has been exposed by the removal of the limestone.

I have not been able to ascertain to what depth the limestone extended in the larger excavations. The section (Pl. I, Fig. 2) does not indicate the relative depth of the original excavations, which are here partly filled with loose rocks and earth.

It will be seen by this section that if we suppose the strata to have been originally extended upward, and folded or arched over, as actually appears in other parts of the quarry, we should have a fold within a fold, separated by the spaces (*C*) and (*D*), which have become filled with the limestone; while, as before noticed, portions of the central fold have also been dislocated, forming cavities for the deposition of the limestone.

That such was the actual structure, and that the limestone was deposited in cavities mostly closed at the top, which have since been uncovered and exposed at the surface by the denuding action of the drift, seems to me a reasonable deduction from the facts observed.

It is worthy of note that the gneiss of the enclosing walls of the cavities, and that of the dividing bands and the projecting masses nearly enclosed by the limestone,—is all of the same character with that of the surrounding strata not adjacent to the quarry. A specimen broken from the projecting mass at (*c*) cannot be distinguished from the ordinary gneiss of this region. In the direction of the strike of the strata also, at a few yards distance from the quarries, the common rock of the region is found with apparently no traces of calcareous matter. In the line along which several of the quarries occur, there are intervals of several miles where no traces of limestone have been found, though the ledges are exposed at the surface in numerous places.

The aggregate length of all the limestone deposits that occur along a line of some twenty-five miles in length, is probably less than one thousand feet. The only other quarry at Chelmsford, which lies nearly in the range with the one sketched, contained a mass of limestone filling a cavity of a lenticular form, about sixty feet in length by twenty-five feet in width in the widest part.

Other quarries in Bolton, Stow and Chelmsford, show a similarity in structure to the one described here. The separation into two or more sections by walls of gneiss, may be seen in at least three of

those that I have examined. At one of the quarries on Robbins' Hill, in Chelmsford, it can be seen that the limestone rested against the irregularly fractured ends of strata of gneiss, which fill a small space in one of the excavations, completely dividing the limestone into two masses. A similar appearance is less plainly shown at (e) in the sketch given.

I propose next to present some facts in regard to the mineralogical character and relative position, in these deposits, of the various materials of which they are composed. Some of these facts and conclusions cannot readily be verified by examining the exhausted quarries at Chelmsford, but have been derived from observations made, and specimens collected, several years ago at Bolton, while the work of excavation was still in progress.

The central and principal part of the mass which filled the veins and pockets and constituted the bulk of the deposit, was *a coarsely crystalline magnesian limestone, homogeneous in structure, and showing no traces of stratification.* In examining numerous specimens of this limestone from the different quarries, I have found in it no traces of the eozoonal structure.

The various silicates which form the large number of distinct minerals for which these localities are noted, occur only *attached to, or near, the enclosing walls of the cavities*, and generally in bands or layers, though sometimes irregularly distributed. They are found generally in pretty regular succession. A network of interlacing crystals of actinolite, with smoky quartz, calcite and phlogopite, may be seen attached to the walls; and passing inward there are found pyroxene, scapolite, apatite, boltonite, fine fibrous tremolite, etc.; and also green serpentine in irregular bands or layers, traversed by narrow seams of chrysotile; or scattered through the rock in irregular rounded grains and masses, with intervening spaces filled with calcite.

In these portions of calcite are found the radiating and branching forms that have been identified and described as belonging to the structure of Eozoon. The granules of serpentine are sometimes arranged quite regularly in concentric lines, but more commonly appear irregularly scattered and varying indefinitely in form and size.

Fig. 1 (Pl. II), shows the arrangement of the serpentine in a piece of the Chelmsford ophi-calcite or serpentine limestone. This and the following figures were printed from plates copied by the electrotype process from decalcified surfaces of the rock. In this specimen the larger calcite spaces showed under the microscope a great abun-

dance of the "tubuli" in bundles, and radiating and branching forms.

The undulating line that divides this specimen illustrates the banded structure that often appears in the rock. The tubuli are found on both sides of this line, but are most abundant in the part which shows the coarser structure.

Fig. 2 (also from Chelmsford) shows at the base a mass of the serpentine intersected by narrow seams of chrysotile, and attached to a portion of the rock in which the decalcified spaces show the tubuli in great abundance, *attached to the serpentine grains as if growing out from their surfaces.* Some of the grains are surrounded by a fibrous layer, closely resembling the "true cell wall" of Eozoon, as I have seen it in the Canadian specimens. The surfaces of many of the grains are covered with acicular crystals penetrating the calcite. Some of these, as they extend into the calcite, become rounded and curved, losing the acicular character.

In nearly all the specimens examined, bundles of acicular fibres, apparently of tremolite, are scattered abundantly in the calcite. The appearance of some of these is partially shown in fig. 3.

Fig. 4 represents a specimen which, in its structure, closely resembles the "acervuline" portion of some of the best specimens from Canada. The calcite spaces show the characteristic tubuli of Eozoon, and these are invariably smaller than in the specimens of coarser structure.

I have observed in this piece, also, some traces of a regular arrangement of the serpentine granules (not well shown in the figure). Several of these appear on different parts of the surface arranged in regular curved lines, the granules composing each little arc being of very nearly the same size and form. Curves of this kind formed by four or five grains, or more, are too common to escape notice in a careful examination of the polished surface.

I notice a similar structure in a fine specimen of the eozoonal rock from Canada, which I received from Dr. Hunt.

In some portions of the rock the serpentine appears embedded in the limestone in definite crystalline forms, apparently pseudomorphs of chrysolite, or boltonite. In the quarries of Boxboro' and Carlisle, cinnamon garnet is abundant, associated with scapolite and green pyroxene or coccolite, with calcite. I have examined the calcite of many of these specimens for traces of the eozoonal structure, but, so far, with negative results. In fact, so far as I have observed, the tubuli invariably occur in the rock associated with serpentine.

In a hasty examination of a specimen from Bolton, I at first thought it contained no serpentine, but more careful observations proved that the rock was filled with serpentine grains, so completely bleached by exposure that they were not easily distinguished by the eye.

The question in regard to the particular manner in which these limestones, with the associated minerals, were deposited, and the cavities filled, is one of great interest and importance in connection with this subject. I do not, however, propose to enter into any extended discussion on this point. On this and other questions connected with this investigation, I hope to hear from Prof. Perry of the Museum of Comparative Zoology, who has made extensive observations on the crystalline limestones elsewhere, and who visited the Chelmsford quarries with me last September. I remember distinctly that on entering the first excavation at one of the quarries, he at once pronounced the deposit "a true mineral vein." He had previously expressed a similar opinion derived from my description of these quarries. It had not occurred to me to give them precisely this designation, though I had, as indicated in this paper, become convinced by my own previous studies that the limestones are not true stratified rocks, but are deposits which have filled cavities formed by the folding and faulting of the strata of gneiss.

Some facts have been stated in this communication for which I offer no theories in explanation. I do not claim a sufficient knowledge of the structure of the foraminifera to found any argument upon the microscopic appearances that I have observed, nor do I mean now to enter into a discussion of the general question as to the true character of the *Eozoon Canadense*, as described by Carpenter and Dawson. I am unable, however, to reconcile the facts here stated, with the theory that the forms in these rocks, which have been identified as belonging to the structure of Eozoon, are of organic origin.

On the other hand, it appears to me not unreasonable to infer that the so-called "tubuli" that are so abundant in these rocks *are semi-crystalline forms that have been deposited with the serpentine and other minerals on the walls of the cavities*, by infiltration of waters charged with mineral matters.

Mr. Burbank was followed by Mr. W. H. Niles, who endorsed the views which he presented.

Professor J. B. Perry said:—

It is perhaps fitting for me to offer a few remarks on the "Eozoon" limestone of eastern Massachusetts, since I have been long engaged in the study of the foliated (or Laurentian) series of rocks, in which it occurs; insomuch, also, as I discovered many years ago what seemed to me indubitable evidence that portions of this limestone are of vein-like origin; and because I was the first to suggest, and really to make out, that some of the limestones of eastern Massachusetts have a similar vein-structure. It likewise properly devolves upon me to say something at this time, as, after visiting Chelmsford, and satisfying myself in regard to the actual character of the calcareous masses containing the supposed organic remains, I agreed to present some of the more important points bearing on the stratigraphy of the rocks, whenever my friend, Mr. Burbank, of Lowell, should be ready to discuss the existing evidence, and especially that furnished by the microscope, as to the organic or inorganic character of the enclosed "Eozoon."

As geologists have generally supposed that all limestones are stratified rocks, a few words may be requisite on this point. They are more especially needful at the present time, and in connection with the subject under consideration, as they may serve to meet an objection which is likely to occur to many minds, — particularly such as hold to the organic, or "sedimentary" derivation of all limestones. It is true that Dr. Emmons, as is well known, endeavored to show that limestones occur, not only as stratified beds, but also as intrusive masses; but this doctrine was never widely received, however much truth may have lain concealed at its foundation. Beginning my study of the limestones connected with the foliated series of rocks, in the light of this view, I finally became convinced in 1861, and set forth in a course of lectures delivered during the same year, that some of these limestones in Vermont and New York have a vein-like structure, and should be regarded as true vein-stones. Having entered anew, some four or five years ago, upon the study of the rocks of eastern Massachusetts, I at once became convinced that limestones in Stoneham, Newbury, and some other townships in this portion of the State, are also vein-rocks.

Such limestones are to be met with, as has been in part already implied, in association with the foliated series of rocks, both in eastern and western Vermont, and in various parts of Massachusetts.

They also occur among the Adirondacks of New York. Limestones of this character — hand specimens of which can be scarcely, if they can be at all, discriminated from given samples of stratified Silurian limestones — are likewise found in Vermont, New Hampshire, and elsewhere, in the form of dikes. In most of these cases close examination clearly shows, and perhaps it will hereafter as clearly evince in them all, that the dike-like masses were formed in a vein-like way by gradual deposition, extending from the enclosing walls toward the centres of what once were cavities. Similar masses of calcareous vein-stone are to be met with in St. Lawrence County, N. Y., and in some other places, penetrating beds of sandstone. Indeed, were there time, it would not be difficult to show that rocks of this character may be found in association with formations of greatly varying, if not of almost every, age.

These, and other similar cases which might be readily cited, are suited to remove the objection that all limestones are stratified rocks, and show that no one can reasonably look for, or expect to find organic remains in any such masses. Having made out the points just advanced years ago, in regard to some of the so-called primitive, or saccharoidal limestones, I have been skeptical ever since in respect to the supposed organic nature of the "Eozoon." Accordingly, on the announcement, in August, 1869, of the discovery of this strange form in the limestone of Newbury, I at once discredited its assumed organic character, — discredited the assumption that it represents, as its name indicates, the dawn of animal life on the globe, — on the ground, among other reasons, of its occurrence in calcareous masses of a vein-like origin. Of course, on hearing a few weeks later, of a like discovery in Chelmsford, and seeing a specimen of the rock holding the supposed organic forms, I was prepared by my previous experience for a similar conviction in respect to the matter involved in the new announcement. This I immediately expressed, in one of the lectures on the foliated rocks, which I was then delivering in course, and I was fortunately able fully to confirm my impression by personal examination, on going to the quarry several months later with Mr. Burbank, who had previously, and has since, devoted himself with commendable assiduity and care to the study of these older formations.

On visiting the Chelmsford quarries and observing what had been before considered, and at first sight might be readily taken, as evidence of stratification in the limestone, I was able, because of ear-

lier studies in this direction, at once to detect the falsity of the inference that had been drawn, and to indicate what all the evidence thus far gathered shows to be the true nature of the masses in question. I found, and have since substantiated by various and careful cross examinations, what the advocates of the organic structure of the "Eozoon" seem never to have suspected, that the limestones under consideration are not to be regarded as stratified masses at all; that, while they may appear, on casual inspection, to be laminated, they are really foliated, and the appearance of stratification is thus to be accounted for in another way; and that being unstratified they are not either almost altogether, as has been affirmed of many such rocks, or in any degree made up of organic remains. These calcareous deposits, as should be constantly borne in mind, do not occur in an uninterrupted line, or crop out in ranges at all uniformly continuous, as is usually the case with sedimentary beds. They are isolated masses, generally of greatly varying size (though in the Chelmsford series more uniformity may be observed in this particular) and as ordinarily found upon the surface, they almost invariably appear only at irregular intervals.

It should be also remarked that the limestones at Chelmsford, like other kindred masses, are of a lenticular shape. They occupy, or rather they once occupied — for the limerock has been mostly removed for economical purposes — pockets, irregular and uneven cavities, or in most cases, oven-shaped spaces, more or less lenticular, which were clearly produced by the disturbance of the main formation. This, at Chelmsford, consists almost entirely of gneiss and of gneissoid rocks. The cavities containing the limestone were once plainly overarched by the accompanying gneiss. In places the gneiss now so overarches some of them, and beyond question it so overarched them all before denudation took place, as to make it evidently impossible that extraneous fossils, or any other solid foreign bodies, could have been carried in and deposited in a continuous series beneath the summits, and all along the sides, of the gneissic arches.

Again, these lenticular masses of limestone have that banded structure which is peculiar to one class of veins. They are foliated, in the strict sense of the epithet, there being a series of leaves, or of leaf-like layers, and these having a regular sequence from the walls toward the centres of the cavities. And to this succession peculiar evidence is borne; for there is associated with the successive bands a like succession of different minerals. The orderly occurrence of

these minerals (Mr. Burbank, I believe, was the first to notice their presence in the limestone, on a previous visit) is a striking feature, which may be verified by any visitor who is disposed to be sufficiently pains-taking to go through with the task; while it is certainly well deserving of attention, both in itself considered, and because of the witness it bears in various directions. Indeed, the foliated structure, with its accompanying series of mineral substances, each occurring in a determinate order, evinces that the process of veinous deposition was gradual, and probably long continued; that time enough must have elapsed for one set of ingredients to be brought in and deposited (for fresh supplies, containing some new elements, to be introduced and exhausted), for these again to be superseded, or at least supplemented, by additional and somewhat varying materials, themselves to be in their turn fixed upon the walls in leaf-like layers; also that one of these layers succeeded another in regular gradation, from the sides of the cavities, which in some cases were many feet in diameter, toward the centres, until all the interior spaces were finally filled; and that consequently, the apparent stratification is due, not to aqueous deposition, as ordinarily regarded, but to the vein-structure of the calcareous deposits.

Again it should be remarked that limestone veins, and various irregular apertures filled with carbonate of lime, of smaller size than the main cavities already noticed, may be detected here and there in the walls of the adjoining rock. Indeed, a careful inspection of the quarries reveals the occasional presence of calcareous matter in what were, perhaps, once minute clefts, cracks and crannies in the surrounding gneiss; the presence of matter, which was no doubt introduced into all the smaller crevices, in connection with the deposition of the principal masses of limestone, but long after the formation of the main gneissic rock. This calcareous material which, in places, may be now seen ramifying, in a vein-like way, the walls that form the chief cavities, was evidently connected at some former period with the larger masses of limestone. Such veins, while they are not numerous, or likely to be noticed without careful scrutiny, are of great interest and very significant.

But this is not all; there is other, and what to some will perhaps be more explicit, testimony to the former prevalence of a vein-forming agency. An accurate observer, even the casual visitor, will hardly overlook the marked conformity of the limerock with the

gneiss, as if the former, when in a plastic state, had been moulded upon the latter. Indeed, after careful inspection, one can scarcely fail to note that generally the calcareous bands exactly conform with the most abrupt irregularities and jagged inequalities in the surface of the enclosing walls, and by no means less with the occasional breaks which may be seen in them; that the deposit was everywhere so made, in consonance with the adjoining rock-masses, as to reveal its more recent origin, in connection perhaps with the action of various mechanical and chemical agencies; and, therefore, that instead of being largely made up of the calcareous remains of Rhizopods, it is not at all of a foraminiferous derivation, but took its place in a vein-like way, the material having been probably either forced up from below in a heated state, or introduced from above in the form of an aqueous solution.

In confirmation of the view presented, reference ought to be made to the limestones holding "Eozoon" in other localities, and apparently belonging to the same part of the series of foliated rocks, as well as to what seem to be kindred calcareous masses subordinate to formations of a very different character. Did time allow, I should also especially like to refer to other limestones that are probably closely akin, but perhaps of somewhat varying age, limestones which I have repeatedly examined in their several places of occurrence, though they may not be known to hold "Eozoon." Waiving the consideration of these instances, I may, in a word, simply call attention to some of the calcareous masses in Stoneham, because they are intensely interesting, as suited both to reveal the processes which have been at work in their own formation and to suggest what has taken place in kindred rocks not so easily known; for they have a vein-structure, like that of the limestones of Chelmsford and Bolton. This structure, which seems to be common to the several rocks mentioned, is doubtless due to the operation of the same, or of closely allied causes. Portions of these calcareous masses I have found penetrating the adjoining Syenite, for with this rock in Stoneham they are more particularly associated, in a vein-like way. This limestone also corresponds exactly with the most ragged and broken surfaces, even with all the most diverse inequalities of the adjacent syenitic rocks. In short, it is so situated in relation to them, as clearly to reveal its more recent origin

Such are a few of the more important points characteristic of the

calcareous masses in eastern Massachusetts, which are known to hold "Eozoon," points which each should verify by an actual examination of the masses in question, and of similar rocks so far as accessible and as they occur in place. Whether all the limestones noticed be exactly identical in origin, in structure and in age, or not, they certainly have very many features in common, and are so essentially alike, if one may judge from their appearance, as to serve well to illustrate each other. The question as to the mode of their origin, whether it were by infiltration, segregation, or sublimation, I leave undiscussed for the present, proposing to take it up in detail on some future occasion. Enough, I think, has been said to show that the limestones to which reference has been more especially made, particularly those of Chelmsford, have truly a vein-like structure and are really vein-rocks.

But there is another point, of no small importance, to be briefly noticed. It is a fact, which no one can successfully gainsay or deny, that genuine "Eozoon"—"Eozoon," which has been recognized and is accredited as genuine by those who hold to the organic nature of this marvellous form, and as advocating it are supposed to be best qualified to judge of its character—actually occurs in great profusion, in some of the limestones of Chelmsford.

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Meanwhile, the evidence now presented, evinces, so far as it is readily possible to evince, the inorganic character of the limestones under consideration. And while it seems thus clearly to show that the so-called "Eozoön" of Chelmsford is not an organic structure, it at the same time indicates the probability that the "Eozoonal" forms furnished by limestones of the Grand Calumet in Canada, of Bavaria and Bohemia, of Ireland and of other regions, have the same or a kindred origin, and therefore that they are likewise inorganic. Indeed, so far as I can see, the evidence casts discredit upon the assumed organic character of the "Eozoon" generally, and fixes the burden of proof upon its advocates, to whom it originally belonged, and with whom of good right it should have always remained. It with equal certainty suggests that the resemblance which the "Eozoon" bears to animal structure, is, like that of "Dendrites" to vegetable forms, merely the result of chemical agency; in other words, that the "Eozoon" properly belongs to the department of Mineralogy, and not, as has been claimed, to that of Palæontology.

Dr. T. M. Brewer presented, from the Smithsonian Institution, two forms of the *Quiscalus*, (crow-blackbird,) and exhibited a third form of the same. They are species or races of the *Q. versicolor*. The exact distribution of these varieties is not fully determined. The common *Q. purpureus* is an Eastern species, confined to the belt between the Alleghanies and the Atlantic. At the West, from Texas to Canada, it is replaced by the *Q. æneus*, which has a more brilliant violet hue on the head, throat, breast and upper neck, while the rest is of a fine bronze color. This species (or race) extends through Northern New York to Calais, Maine. Both species, probably, occur in Massachusetts, the *purpureus* resident and the *æneus* migratory. In Florida the *purpureus* is replaced by a smaller race, its miniature in all respects, except the bill, which is much larger. This is *Q. aglaius*.

He also called the attention of the Society to the interest attaching to the specimen of *Erismatura Dominica*, the gift of Mr. Thure Kumlien of Busseyville, Wisconsin. It is a South American bird, and this specimen is the second obtained in the United States. The first was shot at Lake Champlain,—a male, and was presented to the Society by Dr. Samuel Cabot. This specimen, the second ever obtained north of Mexico, was shot at Rock River, Busseyville, Wisconsin, November, 1870. It is a female; its total length is fourteen inches; alar extent, twenty and one-half inches; wing, five and one-half inches. The tail consists of twenty very narrow feathers, of which the first is the shortest. The tail extends only three inches beyond the folded wings. Bill one and six-sixteenths inches from base to tip above; one and nine-sixteenths depth at base and three-fourths of an inch wide. Wing with second primary longest; third and first even. Iris, brown.

The Nominating Committee reported a list of officers for the ensuing year.

Specimens were exhibited of mammals of New England, purchased by the Sidney Homer bequest, of mounted birds, among them an albino swallow, and tortoises from Wisconsin, presented by Mr. Thure Kumlien, and rocks and plants from the Pacific coast, by Dr. S. Kneeland, a herbarium of Belgian cryptogamia from Mr. Andrews, and the anterior portion of an albino porcupine, from Mr. M. L. Bruce. The thanks of the Society were voted for the latter gift.

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Section of Entomology, April 25, 1871.

Mr. F. A. Clapp in the chair. Eleven members present.

Mr. Philip S. Sprague reported, that having been employed for some time in revising the family of *Scolytidæ*, and arranging the Society's material, he had found the use of the higher magnifying powers and a very careful dissection requisite. The funiculus of the antenna of *Xyleborus*, which was believed by Dr. Leconte to be four-jointed, proves five-jointed under a power of 200°. Eight species, representing four genera of this family, had been met with during a recent collecting trip in the vicinity: *Cryphalus asperulus* Lec., found under the bark of the smaller branches of the white ash, measuring only .02 of an inch, was especially interesting from the construction of its burrow; this was invariably in the form of a cross, the shorter arms each little longer than the body of the insect, while the longer arms frequently encircled the twig. In answer to a question from Mr. E. Burgess concerning the purpose served by the characteristic sculpture of the apex of the elytra in this family, Mr. Sprague said that he thought these rugosities might enable the insect to brace itself more firmly against the material excavated, or assist in the removal of excreta.

Mr. Charles S. Minot exhibited specimens of the so called Tarantula of California, (the trap-door spider, *Mygale Hentzii* Gir.) and its nest, from aluminous soil, three or four inches deep, lined with two layers of silk. Also specimens of *Pompilus formosus*, a wasp which attacks and destroys the spider. He gave an interesting account of the manner in which the wasp paralyzes or renders its victim helpless. This species is very sensitive to odors, many individuals being frequently attracted to the spot where a spider is being victimized.

Mr. Edward Burgess described and figured the peculiar sexual markings of some of the Diptera, *Dolichopus pugil* Loew, and other species of this genus, showing the variations in the feet, antennæ, and wings; these in several species are rounded in the female but squarely cut in the male. He called attention to the views of Darwin in his recent work on the selection of species, citing the Dipterous family *Bibionidæ* as affording very interesting characteristics.

Mr. S. E. Sargent, of Boston, was nominated for membership in the Section.

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## Annual Meeting, May 3, 1871.

The President in the chair. Thirty-nine members present.

Prof. Alpheus Hyatt presented the following report of the Custodian for the present year.

My predecessor, the distinguished entomologist, Mr. Samuel H. Scudder, held three offices, Custodian, Secretary and Librarian; these at the last annual election were divided, Mr. J. A. Swan being selected as Secretary and Librarian. This division places the Museum more especially in my charge.

The fact that the Society had no declared policy attracted the attention of the Committee who settled the terms upon which I was to serve, and they requested me to draw up a plan of organization. This was done after consultation with various members of the Society, and the provisional plan laid before the Council was, in all its essential features, adopted; but at my own request, it will remain on trial until sufficiently tested by practical application. The general considerations, however, which furnished the groundwork of the principles therein laid down, have been sufficiently matured by our own experience and that of other scientific institutions, both at home and abroad, to be announced now.

The history of the Society shows that it is eminently a social organization, devoted to the cultivation and diffusion of scientific knowledge. This is plainly stated in the address of the first President, Mr. Greenwood, in 1833. The publications and museum were then considered as necessary parts of the design, the former as a means of self-culture and correspondence with distant institutions, and the latter, as the most suitable medium for diffusing knowledge among the people.

Though these objects have never been more minutely defined, they have since served as the ground-work of all the progressive changes in the administration of the Society. The experience of the past thirty years, however, shows the insufficiency of our means to cover the whole field, which a practical application of such general principles embraces. Even were this not the case and our funds larger than they are, it would still be necessary to remember that we are no longer solitary.

There are six other institutions in our vicinity, five of which have museums and are devoted to the cultivation of Natural History.

Coöperation in some definite form with them all is to be anticipated, and in fact has commenced between this Society

and the Museum of Archæology and Ethnology at Cambridge. The first step in this direction demands a thorough acquaintance with our present position and a complete definition of the future policy to be pursued. In this way, the Society will be ready for the consideration of any scheme of coöperation, and what is still more important, feel in the meantime that its expenditures, whether of money or labor, are distributed judiciously. Another reason for a definition of our plans lies in the fact that Societies are liable to sudden changes of policy and should, therefore, have some precise standard of comparison by which the value of each new measure can be judged.

The Society, as it is now constituted, has three well marked divisions,—the meetings, with their attendant publications, especially devoted to the use of the members; the Library, also for the use of the members, but to which, as to the meetings, all respectable applicants have ever been made welcome; and lastly the Museum and Lectures.

The effects of the meetings are too complex to be readily defined. It may be affirmed, however, that they secure mutual good understanding and support between professional men and amateurs, that they furnish to mature minds the most sympathetic of all audiences, encourage the hesitating student to take his first steps in the public service of science, and restrain the hasty and over-confident by the presence of critical judges. They also exercise a powerful influence upon the public at large, by means of the bi-monthly reports of the Secretary, published in the newspapers.

The publications are accessory to the meetings and add greatly to their attractions, besides maintaining creditably our part of the general correspondence now uniting all Natural History Societies and Institutions.

The principal object of the Library must necessarily be the preservation and systematic cataloguing of the books and pamphlets, but it has certain duties, also, in connection with the publications and the purchase of books, which need to be

definitely set forth. For instance, it is evident that the extension of our exchanges should be limited to Natural History periodicals, excluding all political, economical or technological serials, or those which are strictly antiquarian or historical, and do not publish occasional articles bearing upon the sciences of Anthropology and Ethnology.

Mr. Scudder directed his efforts principally to the publications, and to the establishment of a system of exchanges which now furnishes us with nearly all the best Natural History periodicals of the day. Every practical worker on Natural History in this vicinity, to a greater or less extent, reaps the benefit of his labor and admirable perseverance. The Museum, however, to which we now turn, has not received so much attention, and the principles to be adopted in its arrangement require more careful consideration.

The collection in the department of Ornithology is the scientific ornament of the Museum, and it contains numbers of original specimens, whose value to the investigator can hardly be over-estimated. Such collections should be regarded as scientific trusts, which an enlightened policy will not only preserve with the greatest care, but increase for the benefit of posterity.

The situation of this Society obliges us to consider as perhaps the most important part of our duties, the gradual accumulation of a full and complete collection of the animals and plants, fossil and living, as well as the minerals of New England, especially those of our own State.

On the other hand, there are certain special departments, which it would not seem necessary to enlarge beyond the reasonable limits of educational collections. Thus, for example, the Botanical, Anthropological and Ethnological collections at Cambridge and Salem are extensive, and it would be a waste of means to duplicate them.

The relations of the Society to the public, require that the Museum should be made instructive to all visitors seeking either general information or amusement. The initial

labor of awakening a desire for knowledge in the minds of the public, by the exposition of curious specimens, is approaching completion, and even the most ignorant are in some measure prepared to respect any attempt to offer them more solid, intellectual entertainment. The students of the neighboring Institute of Technology and the teachers and pupils of our public and private schools form another important class to whom our collections are useful. These, as well as the public, require such a classification of the specimens as will convey a knowledge of general laws and principles unencumbered by details. Careful pruning of the specimens on exhibition, the concealment of all others in convenient depositories, and the strict limitation of the purchase of specimens to typical forms, are the only means by which we may hope to avoid the accumulation of unsuitable material. The Ornithological and New England collections must be necessarily cumulative, but with correct management may be made subservient to the illustration of general principles without injury to their scientific value. When distributed in faunal groups they can be used to demonstrate certain laws and principles which cannot be explained by the more comprehensive zoological and anatomical portions of the Museum.

These conclusions were thought by many of the most experienced members of the Society, to afford a correct foundation, and in accordance with them a series of practical rules was drawn up and provisionally adopted. With regard to the Meetings, Publications and Library, these rules were substantially the same as those principles which have just been recommended, but in the Museum they were much more minute.

The governing principle proposed for this department was that all the different collections should form together a consecutive series of lessons in the structure of the earth and in the organization of animals and plants. To accomplish this, only such specimens should be exhibited as would prominently represent some definite step in the morphological or

structural series, in each class or minor division of the animal and vegetable kingdoms. Besides these it was proposed to have a more general epitome collection which would enable the student to bind together in one sheaf all the knowledge he might have obtained from the type collections. Though we are apparently far from the final accomplishment of this or any other arrangement, yet the existence of a definite system exerts an excellent and healthy influence.

The difficulties to be encountered in carrying out the details of any scheme will be great or small, precisely in proportion to the feeling which governs the officers entrusted with its execution. If a broad, catholic spirit of consideration for the interests of the Museum obtains, there need be no doubt of ultimate success. On the other hand, if regard for the interests of any special departments is allowed to interfere with the uniform arrangements and proper scientific use of the whole Museum, no very beneficial results can be anticipated. It should be remembered, and therefore make us doubly cautious, that besides our own interest in the matter, the result of such an experiment must become a precedent for similar undertakings, and in the future have a lasting influence upon the development of scientific societies.

The next important event of the year was an agreement made with the Massachusetts Institute of Technology. By the terms of this compact they are permitted the use of the halls of this building and the Museum collections for the instruction of students, controlled by such restrictions as may from time to time be imposed by the Council. In return for these privileges, the Institute pays a certain sum per annum, and deposits, as soon as we are prepared to receive them, the valuable collections and series of diagrams which formerly belonged to Prof. Henry D. Rogers.

This agreement affords the Society an opportunity to aid in the new movement of practical education and to extend its usefulness to a class heretofore beyond its reach,—a class likely, on account of their opportunities in the field and laboratory, to

be of great service to Natural History. This year the coöperation has extended no farther than to the delivery of a few lectures in this Lecture Room, upon Zoölogy, by Dr. S. Kneeland, and a course upon Palæontology by the Custodian.

One of the principal items of expense has been the new heating apparatus. The old cast iron boilers were entirely unfitted for their purpose, and great consumers of coal. These, owing to the exertions and management of the President and Mr. W. T. Brigham, have been replaced by tubular boilers, and also new heating apparatus throughout the building, which has so far worked satisfactorily. The expense of this change—some four thousand dollars, has borne heavily upon all sections of the Museum. Notwithstanding this, however, a well marked advance in the amount of work done in this division is apparent.

The appointment of Mr. F. G. Sanborn as Instructor at the Bussey Institution of Harvard University, withdraws him only to a limited extent from his labors here. Two mornings of each week are occupied by the duties of this office, and the proportional deduction which he personally offered to make from his salary, has enabled us, with the addition of a small sum from the general income of the Society, to employ the whole time of another valuable assistant, Mr. Philip S. Sprague. Mr. Sanborn's almost constant occupation in the general work of the Museum prevents him to a great extent from paying that constant attention to the Entomological collections which their preservation demands.

Mr. Sprague, however, who has been at work for two months past, with the aid of the closely fitting boxes recommended by Dr. Hagen, will, it is hoped, place this collection out of danger.

I desire also to draw special attention to the report on Comparative Anatomy. This shows the unusual activity which has prevailed in that department, and the results are highly creditable to the gentlemen who have worked upon the collection. This, and the reports on Mollusca and En-

tomology, teach us the necessity of securing as early as possible the services of qualified assistants in all departments. Several sections of this Museum, if properly attended to, would require every year as much labor as has been gratuitously expended during the past twelve months upon the Osteological collection alone.

The remainder of this report is compiled from the special reports of the Secretary and Librarian and the Chairmen of the various Committees on the Museum.

LECTURES.

Through the liberality of the Trustees of the Lowell Institute, seven courses of free lectures have been given by the Society. The first course of six lectures, by Rev. John L. Russell, on Cryptogamic Botany, was attended by an average of eighty-five persons; the second course of two lectures, by Prof. J. S. Newberry, on the Cañons of the Colorado and Ancient Civilization of America, by an average of two hundred and eighty-seven persons; the third course of six lectures, by Thomas Dwight, Jr., M. D., on the Comparative Anatomy of Mammalia, by an average of sixty-one persons; the fourth course of four lectures, by Dr. P. P. Carpenter, on a general sketch of Mollusca, by an average of sixty-one persons; the fifth course of two lectures, by Rev. R. C. Waterston, on the Journey across the Continent, or some of the remarkable features of California, by an average of three hundred and thirteen persons; the sixth course of twelve lectures, by W. H. Niles, on the Principles of Geology, by an average of two hundred and thirty-seven persons; the seventh course of six lectures, by Rev. E. C. Bolles, on the Revelations of the Microscope, by an average of two hundred and seventy-nine persons.

These averages indicate, generally, the difference in the public mind between popular and strictly educational lectures, but the extreme severity of the weather during the courses

of Drs. Dwight and Carpenter, must be taken into consideration.

Summing up the result, it may safely be said that the courses have been successful; the character of the lectures and the interest manifested in them indicate that the Society can exercise an influence as an educator, while, at the same time, by the natural reaction of that influence, it will increase its own strength.

This success is mainly attributable to the management and exertions of the Secretary. This gentleman, besides attending at the Library much longer every day than his agreement with the Society demanded, was present at nearly every lecture, looking personally to the comfort of the audience.

## MEETINGS.

Six corresponding and forty-eight resident members have been elected during the year. Of the resident members, three have not completed their membership according to the requirements of the Constitution, and their names do not appear on the records.

There have been eighteen general meetings of the Society, with an average attendance of forty-one persons; eight meetings of the Section of Microscopy, with an average attendance of eleven; seven meetings of the Section of Entomology, with an average attendance of ten. Thirty-seven written communications have been made by twenty-six persons, and eighty-nine verbal communications by thirty-six persons, making a total of one hundred and twenty-six. Of these, thirteen were presented in the Section of Entomology, and thirteen in the Section of Microscopy. Their titles are as follows:—

AGASSIZ, ALEX. On the formation of fiords. *December* 7, 1870.

ATWOOD, N. E. On the habits of the Bluefish. *January* 18, 1871.
Remarks on the habits of the Capelin (*Mallotus villosus*). *March* 1, 1871.

BICKNELL, E. On a Method of producing Low Powers for the Microscope. *October* 12, 1870.

On Flexible Muscular Preparations. *November* 2, 1870.

On the Absorptions of the Frustules of *Isthmia*. *November* 9, 1870.

On the Structure of Whalebone. *November* 9, 1870.

Remarks on Microphotographs of *Amphipleura pellucida* and *Surirella gemma*, taken by Dr. Woodward, U. S. A. *February* 8, 1871.

Remarks on the Sense of Smell, as the guide of many lower animals in seizing their prey. *April* 5, 1871.

BLISS, RICHARD, JR. On the Osteology of Structure of the dorsal fin of *Doras*. *June* 15, 1870.

On markings which distinguish young from adult fishes. *January* 18, 1871.

BOUVÉ, T. T. On Conglomerate. *October* 19, 1870.

BREWER, T. M. On the Nest of the Baltimore Oriole, made of Spanish Moss. *May* 18, 1870.

On the Nests and Eggs of some of the most rare Birds of high latitudes. *February* 1, 1871.

Remarks on *Casuarius Bennettii*. *March* 1, 1871.

On the Varieties of the Crow-Blackbird. *April* 19, 1871.

BRIGHAM, WM. T. On Meteorites from Tucson, Arizona. *May* 18, 1870.

On a deposit of Lava on the Columbia River. *May* 18, 1870.

On the *Sequoia gigantea*. *May* 18, 1870.

On *Morchella* from Grafton, Mass. *May* 18, 1870.

On the System of Volcanoes in Mexico. *February* 15, 1871.

On Water as an element of Volcanic Eruptions. *February* 15, 1871.

Remarks on a Conglomerate Lava in one of the Hawaiian Islands. *February* 15, 1871.

BROWN, F. H. On Ferns and Fern Allies of Medina and Porto Santo. *May* 18, 1870.

BURBANK, L. S. On the Origin of the Eozoonal Limestone of Chelmsford and vicinity. *April* 19, 1871.

Burgess, Edward. On Dr. Hagen's Collections of Neuroptera. *May* 25, 1870.
On the Anatomy of *Darapsa myron*. *December* 28, 1870.
On the Genital Armature of male Lepidoptera. *January* 25, 1871.

Carpenter, P. P. On the Family of Chitons. *January* 4, 1871.

Clark, Henry James. On the Anatomy and Physiology of our common *Lucernaria*. *February* 1, 1871.

Cope, E. D. On Three New Species of *Pythonomorpha*. *November* 2, 1870.

Dall, W. H. On Arrangement of the order *Docoglossa*. *October* 19, 1870.
On the Relations of the class Brachiopoda. *February* 15, 1871.

Dwight, Thomas, Jr. On flexible anatomical preparations, *October* 5, 1870.
On Supernumerary Limbs in Fowls. *October* 5, 1870.
On Supernumerary Limbs of Fowls. *January* 4, 1871.

Edwards, A. M. Notice of an Undescribed Form of *Pleurosigma*; family *Diatomaceæ*. *April* 5, 1871.

Emerton, J. H. On *Myrmeleon immaculatum*. *December* 28, 1870.
Remarks on the Structure of Spiders. *January* 25, 1871.

Farlow, W. G. On the Marine Algæ of the east coast of the United States. *December* 7, 1870.

Fontarive, E. On a new stand for the Microscope. *March* 8, 1871.

Greenleaf, R. C. On an infusion of mutton which showed molecular motion. *January* 11, 1871.

Hagen, H. A. On the Deyrolle Collection of *Curculionidæ*. *November* 23, 1870.

Harriman, G. B. On the Fibrous structure of Bone. *December* 14, 1870.

Hunt, T. Sterry. On certain features of the Geology of New England. *October* 19, 1870.

HYATT, A. On the Classification of Brachiopoda. *June* 1, 1870.
On Preservative Fluids. *October* 5, 1870.
On the Law of Acceleration in the development of certain types of animals. *October* 5, 1870.
On Revisions among the Ammonites. *October* 5, 1870.
On the Embryology of Nautiloids. *November* 9, 1870.
On Comparison of Soundings of East and West North American coasts. *November* 16, 1870.
On the Elevation and Depression of portions of the Atlantic coast. *February* 1, 1871.
On the affinity of the Polyzoa and the Brachiopoda. *March* 15, 1871.
Remarks on Natural Selection. *April* 5, 1871.

JACKSON, C. T. On Meteorites. *May* 18, 1870.
On Lingula. *June* 1, 1870.
On an Analysis of the Rocks in the vicinity of Boston. *October* 19, 1870.
On Glacial and Drift Phenomena. *December* 21, 1870.
On the Elevation and Depression of the Atlantic coast. *February*, 1871.
On some Peculiarities of Volcanic Action. *February* 15, 1871.

JACKSON, J. B. S. On Anatomical Preparations. *October* 5, 1870.

JEFFRIES, B. JOY. On the Absence of Color-Perception in Animals. *April* 5, 1871.

KNEELAND, S. On Optical Illusion. *November* 2, 1870.
On the Geology and General Features of the country about the upper Mississippi. *November* 16, 1870.
On the mechanical action of Sand driven by a blast of air or steam. *April* 15, 1871.
On the Habits of Flying-fish off the Pacific Coast. *March* 15, 1871.
On the Habits of some of the Pacific Water-birds. *March* 15, 1871.

KNIGHT, C. F. On the Turtles of Florida. *June* 15, 1870.

MAACK, G. A. On the Geology of the Argentine Republic. *June* 1, 1870.

MANN, B. P. On Carbolic acid as a Preservative fluid. *June* 15, 1870.

MINOT, C. S. On the Flight of Diurnal Lepidoptera. *October* 26, 1870.
On *Lycæna* occurring in New England. *November* 23, 1870.
Remarks on new Lepidoptera of Iowa. *January* 25, 1871.

MORSE, E. S. On reclassification of the Brachiopoda. *June* 1, 1870.
On the Sipunculoid worm *Phascolasma*. *November* 16, 1870.
On the Relations of the Brachiopoda. *March* 15, 1871.
Remarks on some features common to the Vermes and the Vertebrates. *March* 15, 1871.
On the Early Stages of the Shell of *Anomia*. *April* 5, 1871.
Observations on the protective coloration of Mollusca. *April* 5, 1871.

NILES, W. H. On the System in the Physical features of Massachusetts. *May* 18, 1870.
On the Conglomerate passing into Porphyry at Dedham. *October* 19, 1870.
Observations on a Gneiss Quarry at Monson, Mass. *January* 4, 1871.
On the Parallelism between the Atlantic Valley and the Appalachian Chain. *February* 1, 1871.
On the Conglomerate Pebbles at Montague. *February* 15, 1871.
On Lateral Change in a bed of Conglomerate at Chestnut Hill. *February* 15, 1871.

PACKARD, A. S., JR. Catalogue of the *Phalænidæ* of California. *May* 4, 1870.
On new and interesting Neuroptera. *May* 4, 1870.
On the Embryology of *Isotoma*. *June* 15, 1870.
On the Embryology of *Limulus Polyphemus*. *November* 16, 1871.
On a new species of *Pauropus*. *November* 16, 1870.

PERRY, J. B. On the Glacial period in New England. *December* 7, 1870.
On Glacial action and drift phenomena. *December* 31, 1870.
On Gradual Changes of Strata, caused by variations of temperature. *January* 4, 1871.

On Drift Phenomena. *January* 18, 1871.

On the formation of the Atlantic Coast line. *February* 1, 1871.

On the Presence of fossil Brachiopods in the primordial rocks. *March* 15, 1871.

Remarks on Eozoon in some quarries of Massachusetts. *April* 19, 1871.

PICKERING, C. On *Lingula* at the Feejee Islands. *June* 1, 1870.

On the Drift in the vicinity of Salem. *January* 18, 1871.

An Illustration in the Hawaiian Islands of water maintained at the surface of the globe by central heat. *February* 15, 1871.

Remarks on the character of the eruptions of Kilauea and Mauna Loa. *February* 15, 1871.

On the General Distribution of the Conglomerate, and its formation. *February* 15, 1871.

POURTALES, L. F. DE. On deep sea soundings off the east coast of the United States. *November* 16, 1870.

PUTNAM, F. W. On Mr. Bliss's communication. *June* 15, 1870.

On the Turtles presented by Mr. Knight. *June* 15, 1870.

On an Eel, from the coast of Africa, containing a large, spiny, bream-shaped fish. *March* 1, 1871.

On the Classification of Fishes. *April* 19, 1871.

RICHARDS, L. S. On stones marked with glacial scratches, taken from Fort Hill. *April* 5, 1871.

SANBORN, F. G. On the capture of interesting Lepidoptera at Milford, N. H. *May* 25, 1870.

On Lepidoptera from California. *October* 26, 1870.

Remarks on habits of *Forficula*. *January* 25, 1871.

SCEVA, GEORGE. On the habits of the Cobra di capello. *January* 18, 1871.

On the absence of the third molars in Hindoo skulls. *March* 1, 1871.

On the poison of the Cobra and of the Rattlesnake. *March* 1, 1871.

SCUDDER, S. H. On Mr. Morse's Classification of the Brachiopoda. *June* 1, 1870.

SHALER, N. S. On the Progress of Life on the several continents. *June* 15, 1870.

On the Geological Structure of the Wachusett range. *June* 15, 1870.

On Stratification at Braintree. *October* 19, 1870.

On Roxbury Conglomerate. *October* 19, 1870.

Changes on the Atlantic Coast, and denuding action of Ice. *November* 2, 1870.

On the life of lower latitudes passing further north. *January* 18, 1871.

On the Chesapeake Bay and the shore line thence southward. *February* 1, 1871.

SPRAGUE, P. S. On Parasitic Insects. *October* 26, 1870.

STODDER, C. On a section of Tiger wood from Brazil. *May* 11, 1870.

On Albumen coagulated with carbolic acid. *October* 12, 1870.

On a series of lenses constructed by R. B. Tolles. *January* 11, 1871.

TUTTLE, A. On a form of *Paramœcium* from Fresh Pond. *November* 9, 1870.

On the Fissiparous reproduction of *Stentor*. *February* 8, 1871.

UHLER, P. R. Notice of some Heteroptera in the collection of Dr. T. W. Harris. *February* 1, 1871.

WATERSTON, R. C. On a visit to California. *November* 16, 1870.

WILDER, BURT G. On Intermembral or Limb Homologies. *April* 5, 1871.

WINSLOW, C. F. On a mortar-shaped pebble from the banks of the Rhine. *October* 5, 1870.

At the beginning of the year, a committee was appointed to look after the general meetings and solicit the proper kind of communications. The list above and the larger average attendance show a decided improvement resulting from this measure.

## PUBLICATIONS.

The radical changes made in the basement during the summer and autumn have materially impeded the regular issue of the publications. Eleven signatures of the Proceedings have been issued, completing the thirteenth volume, and four signatures of the fourteenth volume are already in type. One paper of the Memoirs, "Historical Notes of the Earthquakes of New England," by Mr. William T. Brigham, has already appeared; the second paper, "Early Stages of Terebratulina," by Prof. Edward S. Morse, is ready, and only waiting for the plates; the third paper, on the "Osteology and Myology of Didelphys Virginiana," by Elliott Coues, M. D., U. S. A., with an appendix by Prof. Jeffries Wyman, M. D., is well advanced and will soon be issued, completing the first annual part of the second volume.

There is now a fair prospect that both the Proceedings and Memoirs will be issued with the promptness which has hitherto characterized the publications of the Society.

## LIBRARY.

The accessions to the Library during the year by gift, exchange and purchase, number 1185, which may be classified as follows: 215 volumes, 765 parts of volumes, 183 pamphlets and 22 maps and charts.

The disturbed state of the countries from which many of the exchanges come will suggest the cause of this reduced number compared with that of the preceding year.

The appeals made to societies for volumes and parts to complete our imperfect series, have in several instances been responded to very generously. From the Zoölogical Society of London, we have received the first five volumes of its Transactions nearly complete. Two or three parts being out of print could not be supplied.

Several societies to whom our Memoirs, Proceedings and occasional papers have been sent, have for the first time honored us with their publications.

From the Gessellschaft von Freunden der Natur-wissenschaftlichen at Gera, we have received ten parts; from the Gesellschaft für Natur und Heilkunde at Dresden, six parts; from the Naturhistorische Verein, at Passau, eight parts; from the Museum of Economic Geology and Geological Survey of Great Britain, Vols. 1–3 of its Memoirs, together with several valuable volumes of local Geology.

We have opened correspondence with one new Society: the Verein zur verbreitung naturwissenschaftliche Kenntnisse, in Wien. Seven volumes of its publications have been received, and portions of our own have been sent in exchange.

Many of the series, and often those most called for, are incomplete, and much complaint is made because a desired part or volume is wanting. The librarian would recommend that at least the more valuable of these imperfect sets be filled out, since the value of a library often depends more upon its completeness than upon the number of the titles in its catalogue.

The librarian also represents that the alcoves in the gallery assigned to the publications of Societies, are overcrowded. He would therefore recommend that, as soon as practicable, galleries be placed in the back room and furnished with a number of cases sufficient to receive the books belonging to "A Republican Institution." The removal of these from their present position would give ample space.

There are several hundred parts of volumes and pamphlets which have been classified during the last year, but not yet properly incorporated into the library. There is also considerable work to be done in re-arranging the catalogue, owing to the removal of books from one alcove to another, a work on which the assistants have for some time been diligently employed and which still remains to be done. The librarian believes this can be entirely completed during the comparative leisure of the summer months.

The number of members who have taken books from the

library and the number of books loaned, correspond very nearly with the statistics of the preceding year.

The use of the library has been given to the members of the Institute of Technology and to others, who pursuing some branch of natural science, have made personal or written applications for the favor.

We have again to express our indebtedness to the officers of the Smithsonian Institution, for the uniform courtesy and liberality with which they have gratuitously transmitted our own publications and received for us those of foreign societies.

### MINERALOGY.

The mineralogical department is indebted to Messrs. J. Carson, N. H. Bishop, A. K. Cole, W. T. Tracy and Dr. S. Kneeland, for interesting specimens. Additions have also been made by exchange, and a fine series, including many rare species, has been acquired by purchase. The collection is reported by the Committee to be in perfect condition, well arranged, and every specimen properly labelled.

### GEOLOGY.

This department is reported to be, as formerly, fully arranged and labelled. No additions of special importance that need to be mentioned.

### BOTANY.

The Herbarium in the Department of Botany has been carefully examined and rearranged according to the Genera Plantarum of Hooker and Bentham, so far as it has been published. This is in continuation of the work begun by the late Horace Mann.

Some 25,000 specimens in all have been labelled and glued to papers, and many hundred duplicates separated for exchange. The Herbarium now contains no loose plants, and is wholly free from insects. The cases, however, are unsuitable

for their purpose and do not even exclude the dust, which damages the collections.

Many hundred specimens from various expeditions are labelled simply with numbers, and where the Reports have not been published, would require much work for their correct identification. This, however, should be done and the assistance which is necessary should be obtained, since the specimens are very valuable in themselves, but of no avail in their present unnamed condition. An appropriation of $150.00 would be desirable for this purpose.

A nearly complete copy of "The Flore Cryptogamique de la Belgique," has been presented by Mr. Andrews, of Boston. A few Hawaiian plants have been added to the Herbarium.

The Ingalls Collection of paintings now deposited with the Society, may be, it is hoped, retained permanently as the property of the Society, but at present the price asked by the owner is beyond our means.

### PALÆONTOLOGY.

The specimens which have been accumulating for years past have been unpacked, partly identified, labelled and placed in the cases. A preliminary review of the whole collection has been completed, in order to determine the number and quality of the specimens, and the proper mode of arrangement to be adopted. During this review, some very valuable specimens which had been displaced were discovered and restored to their proper places. The best manner of mounting has also been considered and experiments made.

It is proposed to secure the specimens to wooden tablets by wire fastenings. The colors to be a light grey for the Silurian, a delicate, reddish brown for the Devonian, a shade of yellow or buff for the Carboniferous, a lighter blue for the Mesozoic, and a deeper shade of blue for the Tertiary and Post Tertiary.

## COMPARATIVE ANATOMY.

The Committee found this collection in poor condition at the beginning of the year, and much time was expended in cleaning the specimens and cases. The sashes of the latter had been loosened and admitted the dust freely, but this to some extent has been corrected by a system of fastenings devised by Mr. Sanborn.

The whole collection is now in excellent order. The Society owes this to the exertions of Dr. Dwight and his assistant, Mr. Fletcher M. Abbott. The most important addition is the skeleton of a whale, the carcass of which was presented by Harvey T. Litchfield, Esq.

This skeleton is probably the most perfect in this country, and was secured to this Society for the small sum of $275.00. It is now in course of preparation, and will be described and mounted by Dr. Dwight. The Society owes the perfection of the skeleton principally to Mr. Sanborn's constant care of the carcass until the bones were safely secured in the building.

A skeleton of *Globicephalus melas*, common "black fish," of our coast, has been sorted out from a confused mass of bones with great labor, by Dr. Dwight, and is now mounted. The specimen referred to is over fifteen feet in length.

A collection of the disarticulated bones, or rather parts, of the skeletons of the representative forms of the mammalia have been preserved, mounted and placed on exhibition. This collection enables the student to compare the morphological relations of the anterior and posterior extremities in each type, and the general and special relations of the parts of the skeleton to each other throughout. Thus a visitor is able to observe either one single typical skeleton, standing vertically with all the parts slightly separated, but still sufficiently near to each other to show their dependence; or he may run his eye through the whole series, isolating some one

bone, and following it through all its more important modifications within the class.

Several alcoholic preparations have also been made.

A system of mounting upon painted tablets, recommended by Dr. Wyman, has been adopted with admirable results. For white objects like bones, blue is preferred, and the effect is far superior to the funereal appearance of the black tablets previously employed.

The Committee in their report, thank Mr. Abbott for the gratuitous services which he has so generously rendered.

## RADIATA.

Mr. Sanborn has cleaned the cases and rearranged the corals and sponges, placing the whole upon black tablets, He also began the labelling of the species, but found that only about twenty per cent. had correct names. It is very important to this collection to secure, if possible, the services of Prof. A. E. Verrill, for the naming and labelling of the species. The gorgoniæ and sponges also should be mounted, so as to be safe from careless handling. Mr. Minot has begun the study of classification and anatomy of Echinoids, and the best mode of mounting and displaying this collection is now under consideration.

## INSECTA.

Mr. Philip S. Sprague, though only employed for two months, has already arranged and placed in trays 160 species of the Curculionidæ, 206 species of the Cerambycidæ, and 199 species of Chrysomelidæ, 51 species of Coccinellidæ, 45 species of Endomychidæ — a total of 671 species. These are New England Coleoptera, and have been placed in the railing cases as part of the collection of N. American Coleoptera, begun and partially completed by Mr. Sanborn and Mr. G. D. Smith. The former generously placed his collection of Coleoptera at the disposal of Mr. Sprague, who has selected many species therefrom to fill blank spaces in the Society's

collections. The balance of the specimens consist of the duplicates of the Harris, the remnants of the Say and Hentz, Shurtleff and Stratton collections. Mr. Sanborn, despite the numerous demands upon his time, has continued the work of labelling and arranging the Lepidoptera.

The Society's entire collection of N. American Bombycidæ, largely increased by donations to supply deficiences from Messrs. Swan, Trouvelot, Sprague, Dickinson, Minot, and Sanborn, is now displayed in the railing cases, properly labelled and in good condition. Mr. Minot has devoted much time to the Phalænidæ and Noctuidæ during the year, and the arrangement and labelling of the former family is now nearly completed. The collection of Butterflies of New England has been increased by more than 40 specimens from Messrs. Scudder, Edwards, Whitney and others, several of these being more than usually valuable, as types of the plates in Mr. Scudder's forthcoming work; this department has also been relabelled throughout. Over 150 specimens of Lepidoptera, representing 53 species new to the collection, have been purchased from the collector, Mr. G. W. Belfrage, of Waco, Texas; some 20 species received in exchange from California, by Mr. R. H. Stretch, nearly 100 specimens of various orders from California, by Mr. William Holden, and a small lot of new and valuable diurnals from Tarma, Peru, by Mr. M. Moerner, have recently been presented. From Mr. Henry Edwards, of California, a large number of valuable Coleoptera, both dry and alchoholic, have been received in return for exchanges. From Mr. Nathaniel H. Bishop, a number of Cuban insects of various orders, and from Mr. Samuel N. Chamberlain, of Port Orange, Florida, alcoholic specimens of value, numbering over one hundred.

The Lepidoptera of the Sumichrast collection, received in envelopes and alluded to in our last report, have been entirely reset, and about twenty per cent. identified and labelled. More than half the duplicates of this collection, also including the Coleoptera, have been sold at remunerative

prices. A valuable collection of the Ants of Mexico, identified by Mr. Edward Norton, and presented early in the year by Mr. S. H. Scudder, comprising 27 species, represented by 86 specimens, has been labelled and placed on exhibition. Numerous specimens illustrative of habits, transformations, and structure, mostly alcoholic, have been added to the collection. The Myriapoda have been revised, and the North American species carefully identified by Mr. Edward Burgess, and 63 jars containing over 300 specimens, representing 45 species, are now labelled and on exhibition. The Scorpionidæ have also been determined by Mr. Burgess and are nearly ready for the cases.

The Harris collection has been repeatedly examined during the past year, the transfer of the Heterocerous Lepidoptera to the new cases accomplished, and the orders Diptera and Hymenoptera stored for safety in the recently purchased boxes, awaiting a careful transfer to their proper place in the cabinet. The Neuroptera of this collection, by vote of the Committee and consent of the Custodian, have been entrusted for comparison and identification to Dr. H. A. Hagen, of Cambridge, this gentleman having kindly offered to undertake the task.

The Committee feel that the plan adopted in the railing cases for the safety of the collection, having stood some four or five years' test, has proved an entire success, and that the new boxes recently procured after the pattern of those used at the Museum of Comparative Zoölogy at Cambridge, will obviate all danger of future damage from moths or anthreni. They would, however, again suggest that additional accommodation for the display of the specimens is required.

### MOLLUSCA.

Notwithstanding the generous endowment of Miss Pratt, it has been found exceedingly difficult to obtain qualified assistance in this department. Dr. P. P. Carpenter, having been invited to lecture before the Society, his services were

secured, though for two weeks only. During this time he completed the preliminary work of unpacking the accumulations of the last five years and made a temporary arrangement of the shells into families and genera.

The whole collection is now in the cases, and as a large portion is already mounted, there remains only about one-half still in an unfinished state. This very largely consists of duplicates, and, as suggested by Dr. Carpenter, the next step to be taken is to compare the species with our named collection, pick out all the duplicates and make up sets for distribution and exchange. The Amboyna mollusca, collected by Mr. Albert S. Bickmore, are exceedingly valuable, as they furnish us with alcoholic specimens of many Eastern species. Our collection of shells without the addition of specimens in alcohol, from which dissections and examinations of the animal may be made, is comparatively valueless.

Dr. Carpenter also looked over, arranged, and hastily named a small collection of Chitons, also the shells of Guatemala and Cape Flattery, as well as the genera and a considerable proportion of the species of the East India shells which had not been named and mounted previously by Prof. E. S. Morse.

Mr. L. Lincoln Thaxter has continued the New England collection, partly completed and mounted by Prof. E. S. Morse. About fifty species have been added and the whole transferred to a table case where it can be more readily studied. It is intended to illustrate the last edition of "Gould's Invertebrata."

Mr. Arthur Smith has also been employed in sorting out and studying certain portions of the collection.

### FISHES AND REPTILES.

The Custodian has received no report from the Chairman of this committee. Mr. Putnam has named over three hundred species of fishes and the labelling is nearly completed. The collection is very small, and though in good condition,

as far as it goes, its incompleteness is not creditable to the Society. We are deficient in representatives of the larger fishes of our coast, and it is to be hoped that a decided improvement in this respect may soon take place.

The Reptilia, which were arranged last year, remain in about the same condition. This collection, also, is very small and needs many additions.

## ORNITHOLOGY.

There has been the usual activity in this department. Dr. T. M. Brewer has obtained several important additions — one donation from Mr. Thure Kumlein, of several very rare specimens, including the *Erismatura dominica*, from Wisconsin, and a lot from the same gentleman purchased by the Society. Another from the Smithsonian Institute contained an exceedingly valuable series of the nest and eggs of Arctic birds. Other additions will be found in the list of donations.

The Brazilian skins of Dr. Bryant's collection, about 200 species, have been arranged, labelled and catalogued, by Dr. Brewer, all the doubtful species being referred to Dr. Geo. N. Lawrence, of New York. The Guatemalan skins purchased from Mr. Van Patten, have been received and are now being named.

The Custodian has turned his personal attention more especially to the Birds, this being by far the most valuable collection in the building and most likely to suffer from neglect. In order to stop the ravages of anthreni, many expedients have been adopted. Naphthaline has been largely used, but entirely without success. In fact, the use of any such "vade mecum" is often worse than nothing at all, since it leads the persons in charge to place confidence in its apparently favorable effect, and leaves the insects an open field to work in. The birds on the lower shelves alone have become infected, the beetle does not seem to rise above these as long as there are any skins unattacked below. Several expedients have been resorted to, but nothing is apparently so effectual

as constant work. I have had every bird soaked in benzine or C. Naptha, and Mr. Arthur Smith has been employed several hours of nearly every day in this labor, going over and over the collection several times. The results are encouraging. It is found that the Anthreni are confined to a few badly infected birds and decrease in number at each application. Notwithstanding the certainty that the beetles can be exterminated with our present system of constant supervision, the necessity of adopting some better method of preservation is very evident.

The cases are not fitted by their construction either for containing the birds or for preserving them. Mr. Sanborn has devised several ingenious modes of stopping the cracks and stuffing the sashes, but as soon as one is caulked another opening makes its appearance and opens a new road for the incursions of these minute pests.

A catalogue of the birds has been begun, and the work partially completed for the gallery of Water Birds.

## MAMMALIA.

This department, hitherto the poorest in our Museum, is rapidly improving.

A collection of the mammals of New England had been commenced this year and was progressing favorably, though slowly, when we received a donation of one thousand dollars from the estate of the late Mr. Sidney Homer. The Council appropriated this entirely to the purchase of New England mammals and thus secured the completion of this portion of our Museum. Mr. J. A. Allen has purchased several species from Mr. Rich, of Maine, and another lot from Mr. Maynard, of this State. Among them are a fine pair of Otter skins from Maine, and a remarkably fine specimen of Pine Marten. A pair of foxes obtained from Mr. S. Jillson, also might be noticed on account of their fine appearance, and especially the dark color of the throat and breast of one of them. The collection has been named, labelled, and catalogued and

placed on exhibition, by Mr. Sanborn, in the wall cases on the east side of one of the north-west rooms. As these cases are needed for the osteological collection, it will soon become necessary to provide others for the reception of the skins.

### MICROSCOPY.

The material in this department has not been increased by any very important donations during the past year.

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The following report on the financial affairs of the Boston Society of Natural History, for the year ending April 29, 1871, was presented by the Treasurer:—

| | | | |
|---|---|---|---|
| *Receipts.* | | | |
| Dividends and Interest | | | $7,831.64 |
| Courtis Fund Income | | | 696.78 |
| Pratt " " | | | 798.00 |
| H. F. Wolcott Fund Income | | | 538.67 |
| Bulfinch Street Estate Accumulation applied to cost of Heating Apparatus | | | 2,000.00 |
| Walker Fund Accumulation applicable to Repairs and Cabinet | | | 2,975.88 |
| Walker Fund Income (one half.) | | | 1,233.14 |
| Bequest of Sidney Homer | | | 1,000.00 |
| Annual Assessments | | | 1,170.00 |
| Admission Fees | | | 145.00 |
| Total | | | $18,856.56 |
| *Expenditures.* | | | |
| Museum Building and Furniture | | $151.40 | |
| Repairs of Building (including new Heating Apparatus, costing $5,152.43) | | 7,882.64 | |
| Cabinet | | 1,447.42 | |
| Library | | 217.33 | |
| Publications | $2,188.63 | | |
| Less receipts | 98.83 | | |
| | | 2,089.80 | |
| Gas | | 155.70 | |
| Fuel | | 414.70 | |
| Insurance | $1,672.50 | | |
| Less return premium | 802.50 | | |
| | | 870.00 | |
| Salaries and wages | | 6,524.36 | |
| Lectures | $1,365.89 | | |
| Less subsidy of the Lowell Institute | 1,200.00 | | |
| | | 165.39 | |
| General Expenses | | 1,088.33 | $20,507.07 |
| Excess of Expenditures over Receipts | | | $2,150.51 |

The following is a statement of the Property of the Society, exclusive of the Cabinet and Library.

| | | |
|---|---|---|
| ***Museum Building.*** | | |
| Cost of Building and Furniture, per last Report . . | $137,185.66 | |
| Expended during the year . . . . . . . | 151.40 | |
| | | $137,337.06 |
| ***Bulfinch St. Estate Fund.*** | | |
| Note secured by mortgage . . . . . . . | $15,000.00 | |
| 84 Shares Tremont National Bank . . . . . . | 10,122.00 | |
| 2 " Globe " " . . . . . . . | 257.12 | |
| 4 " Ogdensburg & Lake Champlain R. R. Co. preferred . . . . . . . . . . | 421.25 | |
| 19 " Phila., Wilmington & Balt. R.R. Co. . . | 1,038.75 | |
| Cash . . . . . . . . . . . . . . | 48.94 | |
| | | 26,888.06 |
| ***Courtis Fund.*** | | |
| 50 Shares Globe National Bank . . . . . . . | $6,250.00 | |
| 85 Shares Philadelphia, Wilmington & Balt. R.R. Co. | 1,827.50 | |
| $400 U. S. 5-20 Bonds . . . . . . . . . | 425.00 | |
| | | 8,502.50 |
| ***Walker Fund.*** | | |
| Notes secured by mortgage . . . . . . . | | 41,105.00 |
| ***Walker Prize Fund.*** | | |
| 29 Shares Philadelphia, Wilmington & Balt. R.R. Co. | $1,532.92 | |
| 14 " Vermont & Canada R.R. Co. . . . . | 1,429.25 | |
| Cash . . . . . . . . . . . . . . | 233.04 | |
| | | 3,195.21 |
| ***S. P. Pratt Fund.*** | | |
| 58 Shares Philadelphia, Wilmington & Balt. R.R. Co. | $3,057.25 | |
| 50 " Norwich & Worcester R.R. Co. . . . . | 5,212.75 | |
| 10 " National Webster Bank . . . . . . | 1,072.75 | |
| 6 " Boston National " . . . . . . | 657.25 | |
| Cash . . . . . . . . . . . . . . | 67.94 | |
| | | 10,067.94 |
| ***H. F. Wolcott Fund.*** | | |
| $4,000 Bonds Chicago and N. Western R.R. Co. 10's . | $4,058.27 | |
| 42 Shares Philadelphia, Wilmington & Balt. R.R. Co. | 2,800.95 | |
| | | 6,859.22 |
| ***General Fund.*** | | |
| 17 Shares Bates Manufacturing Co. . . . . . | $1,700.00 | |
| 35 " Everett Mills . . . . . . . . . | 3,500.00 | |
| 30 " Hamilton Woolen Mills . . . . . . | 7,500.00 | |
| 80 " Washington Mills . . . . . . . . | 8,000.00 | |
| 13 " Cocheco Manuf. Co. . . . . . . . | 7,800.00 | |
| 2 " Lowell Manuf. Co. . . . . . . . | 1,800.00 | |
| 8 " Laconia Manuf. Co. . . . . . . . | 3,228.69 | |
| 3 " Pepperell Manuf. Co. . . . . . . | 1,800.00 | |
| 1 " Amoskeag Manuf. Co. . . . . . . | 1,400.00 | |
| 3 " Essex County Manuf. Co. . . . . . | 405.00 | |
| 2 " Manchester Print Works . . . . . | 1,550.00 | |
| 1 " New England Glass Co. . . . . . | 620.00 | |
| 2 " Merrimack Manuf. Co. . . . . . . | 2,220.00 | |
| 19 " Neptune Ins. Co. . . . . . . . | 3,160.00 | |
| 18 " Boston Ins. Co. . . . . . . . . | 2,160.00 | |
| 5 " Washington Ins. Co. . . . . . . | 960.00 | |
| 12 " United States Hotel Co. . . . . . | 1,200.00 | |
| 141 " Vermont and Canada R.R. Co. . . . . | 14,135.00 | |
| 95 " Michigan Central R.R. Co. . . . . . | 10,963.00 | |
| 50 " Ogdensb'g & Lake Champl'n R.R. Pref. Stk. | 5,162.75 | |
| 50 " Philadelphia, Wilmington & Balt. R.R. Co. | 2,732.60 | |
| 2 " Boston & Lowell R.R. Co., and Assessment on new Share . . . . . . . | 1,454.25 | |
| 50 " Norwich & Worcester R.R. Co. . . . . | 5,150.00 | |
| 20 " National Bank of Redemption . . . . | 2,465.25 | |
| 26 " Tremont National Bank . . . . . | 3,155.01 | |
| 50 " Atlas " " . . . . . | 6,046.75 | |
| 6 " Globe " " . . . . . | 771.38 | |
| 15 " National Webster " . . . . . . | 1,684.00 | |
| | | 102,723.68 |

| | | |
|---|---|---|
| Brought forward . . . . . . . . . . . . . | | $336,178.67 |
| *Miscellaneous.* | | |
| Unsettled Accounts and Cash . . . . . . | $2,196.69 | |
| Less Indebtedness $1,293.19. Balance of Homer Bequest $894.90. . . . . . . . . . . . | 2,187.09 | |
| | | $9.60 |
| Value of Property April 29, 1871, exclusive of Cabinet and Library . . . . | | $336,188.27 |
| " " " 30, 1870. exclusive of Cabinet and Library . . . | | 324,083.86 |
| Increase of value the past year . . . . . . | | $12,104.41 |

The foregoing statement of Receipts is exclusive of a portion of the incomes of the Bulfinch Street Estate Fund, and of the Walker Prize Fund, and one half of the income of the Walker Fnnd, which are specially appropriated, and are received and accounted for by the Trustees of the Society in their respective reports, to which I beg leave to refer for explanation in detail. The sum of $20,415.00 was received from the Executors of W. J. Walker, on June 4, 1871, in stocks and cash, which is included in the statement of the General Fund; and a reduction has been made in the estimated value of some of the stocks.

All which is respectfully submitted.

E. Pickering,

Treasurer of the Boston Society of Natural History.

*Boston, May* 1, 1871.

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The report of the Nominating Committee presented at the preceding meeting was read, and the ballot ordered.

Messrs. E. T. Bouvé and T. W. Brewer being requested to collect and count the ballots, reported that the following gentlemen were elected Officers of the Society for the ensuing year.

PRESIDENT,

THOMAS T. BOUVÉ.

VICE-PRESIDENTS,

CHARLES T. JACKSON, M.D., R. C. GREENLEAF.

CORRESPONDING SECRETARY,

SAMUEL L. ABBOT, M.D.

RECORDING SECRETARY,

J. A. SWAN.

TREASURER,

EDWARD PICKERING.

LIBRARIAN,

J. A. SWAN.

CUSTODIAN,

ALPHEUS HYATT.

COMMITTEES ON DEPARTMENTS.

*Geology and Minerals.*

Thomas T. Bouvé,
Charles T. Jackson, M.D.,
William T. Brigham.

*Botany.*

Wm. T. Brigham,
Charles J. Sprague,
J. A. Lowell.

*Palæontology.*

W. H. Niles,
N. S. Shaler,
T. T. Bouvé.

*Comparative Anatomy.*

Thomas Dwight, Jr., M.D.,
Jeffries Wyman, M.D.,
J. C. White, M.D.

*Radiates and Crustaceans.*

A. S. Packard, Jr., M.D.,
A. E. Verrill,
Alexander Agassiz.

*Mollusks.*

Edward S. Morse,
John Cummings,
Levi L. Thaxter.

*Insects.*

F. G. Sanborn,
A. S. Packard, Jr., M.D.,
Edward Burgess.

*Fishes and Reptiles.*

F. W. Putnam,
D. H. Storer, M.D.,
J. A. Allen.

*Birds; Nests and Eggs.*

Thomas M. Brewer, M.D.,
Samuel Cabot, M.D.,
J. A. Allen.

*Mammals.*

J. A. Allen,
Thomas Waterman, Jr., M.D.
J. B. S. Jackson, M.D.

*Microscopy.*

Edwin Bicknell,
R. C. Greenleaf,
B. Joy Jeffries, M.D.

The thanks of the Society were voted to Mr. George E. Channing, for a large collection of birds' eggs, made in South Carolina, and presented by him. A vote of thanks was also passed to Mr. J. F. Wood, manager of the Union Stone Company for the highly satisfactory manner in which he had repaired a valuable specimen of footprints in sandstone, from Southern Asia, lately broken by visitors.

It was voted that the thanks of the Society be presented to Mr. John A. Lowell, Trustee of the funds of the Lowell

Institute, for the generous appropriation made by him to sustain the several courses of lectures given under the auspices of the Society, during the past winter.

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May 17, 1871.

The President in the chair. Thirty-five persons present.

Dr. Thomas Dwight, Jr., presented by title, "A Description of the Whale, *Balænoptera musculus*," now in the possession of the Society, with remarks on the classification of the Cetacea.

The Secretary read the following paper:—

CATALOGUE OF THE ORNITHOLOGICAL COLLECTION OF THE BOSTON SOCIETY OF NATURAL HISTORY. BY PROF. ALPHEUS HYATT.

A catalogue of the birds in the possession of this Society is here begun, and the observations recorded are only of such a cursory character as have been made in the course of this work. The subject of the present article, the Spheniscidæ, having been analyzed as a group only by Schlegel, more time and space have been given to them in proportion to the number of species than will be found necessary for other groups. Similar series of observations, however, upon the genera and species will be published, so far as they may be deemed appropriate or useful. The synonymy of each species has been followed out only so far as is necessary in order to settle the appropriate name for each species, and give references to some one or two of the best figures extant.

It is incumbent upon me to express the most grateful acknowledgments to the Smithsonian Institution and Peabody Academy, for the loan of books and specimens; to Prof. S. F. Baird and especially to Dr. Elliott Coues, for revision of my manuscript and proof sheets and many other acts of courtesy and kindness. The note at the end of the enumeration of the species is also by Dr. Coues, and gives an important summary of the principal osteological characteristics of the family.

## SPHENISCIDÆ.

The general affinities of the genera and species of the larger part of this family come to a focus in *Spheniscus minor*. This, while holding a strictly intermediate position, presents a nearer approach to the lowest members of the genera Pygoscelis, Eudyptes and Aptenodytes than any other existing form. Though not very closely related to Aptenodytes, it is quite as near this as any other known species, for, as I shall show in the generic analyses, the resemblance of *Pygoscelis papua* to Aptenodytes is counterbalanced by characteristics which really ally it closely with *Spheniscus minor*. *Eudyptes chrysolophus*, which stands precisely intermediate between Spheniscus and Eudyptes, affords an opportunity of making a new genus founded upon a combination of the short tail and coloration of the former with the bill and head plumes of the latter.

If we consider the three modifications which presumably take place upon the basis of the organization of Spheniscus, we find that they cannot be associated in any system but one of radiating straight lines.

Every series, except Aptenodytes, which has only two very closely allied species, exhibits a decided change in each species. This change in Pygoscelis and Eudyptes carries each species farther from the lowest member, which in each case is more or less like the ancestral form which was probably closely allied to *Spheniscus minor*. It is entirely conjectural, whether Aptenodytes came originally from Spheniscus or *vice versâ*, or whether they both sprang from a common ancestor. Such a question can of course only be settled by reference to fossils, and these, with a single Australian tertiary example, are at present wanting.

The family may be divided into two groups; those with truncated mandible and hooked maxilla, and those with both jaws curved and the spindle-shaped areas of the sides of the mandible bare and highly colored. If it is divided according to the length of the tail feathers, the genus Eudyptes must be dismembered, if, according to the greater or less feathering of the bill, Pygoscelis must be separated into as many groups as it has species, and in either case the genetic connection of Spheniscus with Pygoscelis and Eudyptes is violated. Such a connection may be legitimately inferred in any series of species from the affinities of the adults, when they present in regular succession or gradation a progressive series of changes or

modifications departing more and more widely from some central or original type, whether that type be still in existence or not.

This is undoubtedly the case among the Spheniscidæ. Pygoscelis has a long tail, and step by step the nostrils become feathered; Eudyptes begins lower with a short tail, then a long tail is added and the aberrant characteristics of the bill are increased. Throughout these two genera the bill has suffered considerable modification, but only in one species, *Pygoscelis adeliæ*, is the mandible sharp at the end, and though every other characteristic of the species may have been changed, the mandible remains straight and truncated. In Aptenodytes this law of progress is broken through, and we find not only the long tail developed, but a very long and peculiar bill correlated with a system of coloration distinct from that of all the rest of the family, and apparently an exceptional system of nidification.

According to Jules Verreaux the female of *Aptenodytes Pennantii* carries one egg between the thighs in a pouch formed by a fold of the skin of the abdomen, this pouch disappearing after incubation; *Spheniscus demersus* and one species of Eudyptes which were also examined, deposited and hatched their eggs in the regular way.[1]

It is hardly necessary to repeat the family characteristics, they are so well known to every one. The wings are mere lateral paddles covered by feather scales on the upper side, but by perfect, though short, feathers on the under side. All the feathers are exceedingly immature, and the tail feathers have unusually large, broad shafts.

According to Nitzsch there are no apteria. The feathers themselves are narrow, lanceolate, with a very broad, flat shaft, convex beneath, with the ordinary furrow of the lower surface wanting.[2] The terminal barbs are rigid, bristle-like, and flat, at the lower part soft and downy. The aftershaft is recognizable, and similar to the shaft. The tube is short and fusiform, and discriminated from the shaft by a deep constriction. No specially formed remiges can be detected in the wings, but in the tail stiff rectrices are distinguishable. The feathers of the oil gland circlet have finer but still rigid shafts and much longer, capillary, soft barbs which are downy below. The number of the orifices in the gland was not ascertained. The species examined by him were *Spheniscus demersus* and *Aptenodytes Pennantii*.

So far as my observations have gone there appear to be two forms

[1] Revue Zoologique. 1847.

[2] This is not always the case; often in the younger, and in the wing feathers, and even in some adult feathers, a faint trace of this groove may be observed.

of feathers, exclusive of the tail feathers and the long filiform plumes which occur on the heads of the species of Eudyptes; one is the type found in Spheniscus. This has the barbs and shaft which form the extremity of the feathers dark colored, the remaining barbs and the base of the stem growing lighter until the down at the base becomes perfectly white. The stem is in these very flat, and the bases of the barbs turned where they join the shaft or aftershaft. This division of color I presume takes place when the aftershaft barb takes the place of the true shaft barbs, but this I could not determine satisfactorily. In the feathers of Spheniscus they occupy a considerable proportion of the whole length of the rather short and truncated plume.

In *Aptenodytes Pennantii* the stem, instead of being but slightly inflated at the base as in Spheniscus, is very considerably so; and is, together with the barbs, brownish to the very base as in this genus; the black being, on the contrary, confined to the very summit of the feather. In the form of the stem and its color, the outlines of the feather and the tumidity of the bases of the barbs near the base of the stem, it is very similar to the dorsal feathers of Spheniscus, but in the form of the stem and in size it is precisely like Pygoscelis.

This genus has very large shafts to the dorsal feathers, very broad and abruptly lanceolate, the tube being smaller at the base than in any other genus. The shaft itself is very broad, becoming suddenly acute instead of gradually tapering, and the tip of the feather itself more acute than in either Spheniscus or Aptenodytes. The barbs and stem are dark colored at the summit, but speedily become white and wholly downy at some distance from the base. This renders the tip of the feather much denser than the lower two-thirds and gives an attenuated, ragged look to the whole. Eudyptes has smaller feathers than Pygoscelis and the stem considerably longer and narrower, and not so abruptly lanceolate. The tip of the shaft narrows and gradually reaches nearly to the outline of the barbs — these being very short. The outline of the dorsal feathers is much the same as in Pygoscelis, with perhaps a slightly more acute tip. The long, lanceolate head feathers are peculiar, and differ from the dorsal feathers in the extreme length of the shaft as well as the small size and thinness of the base of the stem, which bears the later developed barbs. The feathers on the back of the heads of the different species of this genus present an approximation to this same mode of growth, the shaft being attenuated. In other genera the head feath-

ers differ from the dorsal ones only in their smaller size and generally attenuated proportions.

The term "scales" used for the abortive feathers of the wing is an awkward substitute for a more technical expression. These are really feathers in which a simple shaft alone is developed, and this becomes very broad and lanceolate in the outer feathers of the wings. The former are merely fringed by the short barbs, but in the centre of the wing true feathers are developed, though the shaft still remains the principal part, and the color of both shaft and barbs is dark nearly to the base. The form and shape of these feathers also accord with those on the back. In Spheniscus and Aptenodytes the shaft is gradually tapering, the terminal and lateral barbs long; in Pygoscelis there is a much more sudden tapering at both extremities, though the barbs are still long; and in Eudyptes there is a gradual tapering with very short terminal barbs.

The feathers of Aptenodytes confirm the conclusion deduced from its other characteristics, that it is nearly allied to *Spheniscus minor.* The differences and resemblances between it and Pygoscelis are precisely what might have been anticipated if both of these had descended from a type having similar characteristics, and standing in the same relative position as *Spheniscus minor* does.

The toes are scutellate on the distal portions, but higher up reticulate with hexagonal and finally tetragonal or rhomboidal plates on the tarsi. The legs are situated posteriorly, the bird standing erect when on land; most of the crura are buried; the tarsi very short, flat and very broad, the tibio-tarsal joint nearly covered by the feathers, the four toes extended forward and are webbed, the hallux very short, lateral,[1] and attached to the base of the tarsus on the inner side. Nails remarkably broad and flat; the middle toe invariably the longest, all of them straight, and webs complete. The bill has the maxilla curved at the tip, and usually divided by lateral grooves in which the nostrils are situated.

## Aptenodytes.

Coloration is markedly distinct. The long narrow horns of orange on the sides of the head, the black of all the fore parts of the head,

[1] Whether the hallux is elevated or insistent cannot be decided satisfactorily, it seems to vary — in some species or rather specimens to be elevated, and in others the nail bends under, touching the ground, and perhaps might be considered as insistent rather than elevated.



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the blue grey of the back of the neck and the partial collar formed by the extension of this color below the lateral orange bands, are all peculiar to the two species representing this genus. The bill is extremely long and shallow, but very wide proportionally at the base, and flattened. The tip is acute and bent in both mandibles. Broad orange colored spaces occupy either side of the mandible for two-thirds of its length, tapering to a point at either extremity.

Nostrils naked and, in the specimen examined, buried in the nasal groove, which is very deep and distinct.

The maxilla is covered with feathers somewhat more than half its entire length. Tail feathers long. Size largest in the family.

### Spheniscus.

The coloration is uniformly dark, strongly contrasting with Aptenodytes in this respect. There is, however, a constant tendency to form a collar around the throat as in *Spheniscus magellanicus*, and to leave the sides of the head lighter colored. The bill is straight, short, laterally compressed, narrow and deep, the maxilla distinctly hooked, the mandible truncated. The feathers extend only a short distance on the maxilla; the nostrils are exposed and naked, the nasal groove being very shallow. In *S. demersus* and its immediate congeners the maxilla has also several sulci towards the base.

The mandible is feathered to the angle of the lower and upper corneous plates of the jaw — about one-half of its length. Tail feathers very short.

### Pygoscelis.

The coloration is uniformly dark, and there is a general tendency to form incomplete hoods of color. Thus, in *P. papua*, the hood is broken by a white semi-lune on top; in *P. antarctica* by white cheeks, the lower border of the hood, however, still remaining as a dark line encircling the throat just below the base of the bill; in *P. adeliæ*, when adult, the hood is complete, but the white cheeks of *P. antarctica* are represented by a semi-circle of white continued upward from the neck towards the eyes on either side.

The bill is straight, not so long and flattened as in *Aptenodytes Pennantii*, but looking quite like the bill of that species. Of course it is destitute of the colored patches on the sides of the mandible, the apex of which is truncated with an ascending gonys, instead of being acute and decurved as in Aptenodytes.

Both mandibles are feathered for at least half their entire length, but the nostrils may be either naked, as in *P. papua*, or covered, as in the other three species.

In *P. adeliæ* the amount of the bill exposed is small, (only about one-third), the nostrils are thickly covered, and the naked angle of the upper surface of the bill is very short. The nasal groove is very abrupt and widens out rapidly toward the skull, instead of being long and narrow as in *P. papua* and Aptenodytes.

Although the bill becomes shorter in this species, like that of Spheniscus, it maintains the breadth of base viewed from above, which characterizes Aptenodytes and Eudyptes. The tail feathers are very long in all of these species.

If now we seek the affinities of the different forms, we are at once impressed by the fact that *P. papua* and *P. antarctica* really represent Spheniscus, and *P. adeliæ* is similar to Eudyptes. *P. papua* possesses the longest and narrowest bill of any, except Aptenodytes; both mandibles are feathered as in *Spheniscus minor*, though the plumes reach farther forward; the nasal groove is also very similar, especially as it is not strictly coincident with the nostrils as in Aptenodytes, but a little above them as in Spheniscus. The gonys is slightly concave, the sides compressed, the tip truncate, and the tip of the maxilla hooked. These characteristics indicate a very decided affinity with *Spheniscus minor*; but for the long tail (longer than that of any other bird of the family except *P. adeliæ*) it might be included in the same genus. Separated by this characteristic we are enabled to pass to *P. antarctica*, in which equally strong affinities are shown in the coloration, etc., but the tail is the same and the bill shows characteristics approximating it to *P. adeliæ*.

Finally, *P. adeliæ* has a beak which in general form and characteristics is like that of Eudyptes; this is apparent in the width posteriorly of the nasal sulci, and the extent to which the mandible is feathered. The mandible, instead of being straight and truncated, with a concave gonys, as in *P. papua* and Spheniscus, is pretty evenly and convexly curved.[1] In this it is peculiar as it is also in the complete feathering of the nostrils.

[1] This was observed in but one specimen, no others being at hand for comparison; and it may prove that the abrupt though even curve, which terminates the mandible, is a varietal difference. It needs a very slight exaggeration of the angularity of the upper portion to make it as decidedly truncated as in Spheniscus.

### EUDYPTES.

Coloration uniformly dark. A complete hood is here general, each of the several species having that pattern. The head feathers are generally longer than in other genera and the top of the head is ornamented by two still more elongated bunches of feathers, forming curly pendent lateral crests. These are of an orange or yellowish hue. The bills are reddish, very short, straight, the maxilla hooked at the end, the mandible truncated, deep and broad at the base as in Pygoscelis. The nasal groove widens very rapidly posteriorly, and the feathers fill the triangular spaces thus made, but do not in any case entirely cover the nostrils, which are almost concealed under the large fold made by the upper edge of the deep nasal groove. The mandible, however, is plumed for more than half its length as in *Pygoscelis adeliæ*. The tail feathers are short in *Eudyptes catarractes*, and long in the other three species. The truncation of the mandible is usually denied, but an examination of the bills of the three specimens in our collection is sufficient to establish the truth of the above; it is hardly so decidedly truncated as in Spheniscus but yet very plainly so. The fullest development of this peculiar bill is in *E. chrysocoma* where the bill is deepest, and least in *E. catarractes*, which resembles *Spheniscus minor* in many of its characteristics, in its color, a dark penguin blue, its short tail and the extent to which both jaws are feathered. In all other respects it is a true Eudyptes. The size and shape of the head and bill, especially the shortness of the latter, the great breadth posteriorly of the nasal groove, and the great breadth of the base of the bill as well as its depth, are characteristics of Eudyptes.

Linnæus, Editio X and XII, has two species, one confounded with Diomedea and one with Phaëton.

### LITERATURE.

The genus Spheniscus was first formed by Brisson (Ornithologie, Tome 6, p. 99), and included one species only — *Spheniscus nævius*, which he identifies as *Diomedea demersa* of Linn., and *Anser magellanicus* of Clusius, Exot. Lib., Cap. v, p. 101. The specimen figured in pl. 9, has the complete collar of the variety described by Forster as *Aptenodytes magellanicus*. Catarractes was also formed by Brisson, p. 102, to contain *Phaëton demersus* of Linn., figured by Edwards, Tome 1, p. 49, pl. 49, and *Aptenodytes catarractes* Forster, Comm. p. 145. 4to. Paris.

Forster, Comm. Society Reg. Scient. Gotting., vol. III, p. 781, characterizes the genus Aptenodytes, and gives descriptions of the following species :—

CRISTATÆ.

*Aptenodytes chrysocoma.*

ALOPHÆ.

*Aptenodytes patachonica.*
*Aptenodytes patagonica* Müller.
*Aptenodytes papua.*
*Aptenodytes antarctica.*
*Aptenodytes magellanicus.*
*Aptenodytes demersus.*
*Spheniscus naevius* Briss.
*Diomedea demersa* Linn.
*Aptenodytes catarractes.*
*Phaëton demersus* Linn.
*Aptenodytes torquata.*
*S. demersus*, var.
*Aptenodytes minor.*

The name Aptenodytes must belong to *A. patagonica*, since *A. chrysocoma* is of the same group as Catarractes Briss., *Spheniscus catarractes* Schl. The genus Pinguinaria has for a type *Pinguinaria patachonica* Shaw, Nat. Miscel., vol. IV, pl. 409, Dec. 1799. Reference is also made to Mus. Leverianum, No. 3, t. 144, p. 11, for first description *P. patagonica*, but this I have not seen.

Eudyptes, Vieillot, Analyse, etc., 1816, p. 67, is the first tenable distinctive name of the crested genus. In 1825, according to Gray, Vieillot used Brisson's original name of Catarractes, which, however, is antedated by Moehring (1752) for a genus of Alcidæ.

Stephens, in Shaw's General Zoology, 1825, established a new genus from the same group, Chrysocoma, which, however, also included *Spheniscus minor*.

Whether Vieillot included in Eudyptes species which were not plumed on the head I cannot say, not having had access to his work.

Pygoscelis has Wagler's authority. From an extract in the Isis, 1832, it may be seen that the characteristics are the "gestalt" of the beak and the length of the tail. These characteristics are taken from Wagler's Nat. Syst. d. Amph., to which I have not had access. The type is *Aptenodytes papua* Forster.

Hombron and Jacquinot, in preliminary descriptions of new species in Ann. de Sci. Nat., 1841, p. 320, describe two species of Eudyptes, and afterward in the publication of results in Voy. au Pole Sud, on pl. 33 of the birds, separate *adeliæ* as *Dasyrhamphus adeliæ*, leaving *antipodes* to represent Eudyptes.[1]

It follows from the preceding review of the different generic descriptions that Linnæus, neither by the position which he gave the group in his system, nor by his confounding it with Phaëton, recognized its real relations to the whole class of birds.

The generic characteristics selected show a similar deficiency. They were taken from the specific differences of the hooking of the maxilla, and the peculiarities of the nostrils and the family characteristic of featherless wings, whereas four toes were used as of specific value in "*Diomedea*" *demersa*, and the freedom of the hind toe as specifically characteristic of "*Phaëton*" *demersus*.

The necessity of separating this very distinct type from the groups with which Linnæus associated it, was first recognized by Brisson, and here we find general characteristics given for the group. These, however, are such as are shared in common with the Colymbidæ with which they were associated; viz., four toes, three joined by a membrane, the fourth separate; the limbs behind are hidden in the abdomen.

The minor divisions were properly enough characterized by the peculiarities of the beak, this being hooked in the Penguins and straight in the Divers. The generic characteristics were a mere transcript of those of the group, except the form of the lower mandible, which is shown to be truncated in Spheniscus and rounded in Eudyptes. The colors of the feathers were very naturally selected as designating the species.

The type of Spheniscus is *Spheniscus nævius*, but it becomes necessary to call it by the name of *demersus*, subsequently given to it by Linnæus. The name would then be as used by Schlegel—*Spheniscus demersus*.

*Catarractes demersus* of Brisson, the same species as *Phaëton demersus* of Linn., is the type of the crested group, but this cannot properly retain the generic designation of Brisson, but must, as previously pointed out, take the name of Eudyptes, Vieillot, 1816, instead of Chrysocoma of Stephens, 1825.

[1] Bonaparte, in 1856, in the Comptes Rendus, institutes the genus Eudyptila upon the *Aptenodytes minor* of Forster

*Aptenodytes chrysocoma*, which is a crested species, and therefore referable to the genus Eudyptes, makes it necessary to select the next species, *Aptenodytes patagonica*, as Forster's type of the genus.

Forster's descriptions, though they did not recognize either of Brisson's divisions, and ignored both of his names, added greatly to the previous knowledge of the species and made the first mention of the crested birds as a group, contrasting them with the Alophæ or non-crested group.

Pinguinaria of Shaw is evidently identical with Aptenodytes of Forster, as may be seen from the figure of the type in Nat. Miscellany, vol. 11, pl. 409, Dec. 1799.

### APTENODYTES.

**Aptenodytes Pennantii** Gray.

*Aptenodytes Pennantii* Gray, Ann. Nat. Hist. 1844, vol. XIII, p. 315. Patagonian Penguin, Pennant, Trans. Phil. Soc; vol. 58, p. 91, pl. 5, nec Forst.

*Pinguinaria patachonica* Shaw, Nat. Miscellany, 1799, pl. 409.

The distinctive characteristics of this species as defined by Gray appear to be sufficiently well marked in the single specimen which is in the collection. Comparison with a specimen in the Museum of Peabody Academy at Salem shows, however, that considerable variation must be expected in the coloration. The patches on the sides of the head in our specimen are of a decided orange; they are also quite narrow above; the orange on the throat very broad and quickly fading into lemon color, the greenish tips of the dark feathers of the throat and forehead hardly perceptible. In the Salem specimen the patches are very broad above, and bright lemon color fading into orange, the orange on the throat fading very gradually into lemon and this zone, partly, but not wholly, owing to bad stuffing, is long and narrow; greenish feather tips distinctly marked on the throat and forehead. The Museum possesses no specimen of the Emperor Penguin, *Aptenodytes patagonica* Forst., so that no comparison could be made. The wings are quite dark underneath, the white occupying the larger part of the centre only. About three scutella on each toe.

One adult, Str. Magellan, Coll. La Fresnaye.

### SPHENISCUS.

**Spheniscus minor** Temm.

*Spheniscus minor* Temm., Man. Orn., 2d Ed., 1820, 1, p. 113.

*Aptenodytes minor* Forst., Comm. Soc. Reg. Scient. Gotting., 1760, vol. III, p. 147.

*Spheniscus minor* and *undina* Gould, Birds of Australia, pls. 84 and 85.

*Spheniscus minor* Schlegel, Museum des Pays Bas, Urinatores, p. 10.

Gould's figure is excellent, but the light feet are probably liable to become dark in some specimens, and I am even disposed to credit the assertion of Latham, that some of these birds have red feet and are occasionally marked with black on the toes. Several of the specimens in our collection though much faded, show the reddish tinge quite distinctly, and one only has the feet so light colored that they approximate to the variety figured by Gould. Latham also remarks that the absolute size and color of the feathers vary exceedingly on the back; this indicates that *Spheniscus undina* of Gould is only a small sized, perhaps more or less localized variety of *Spheniscus minor*, if, indeed, it be anything more than a young bird. The wings are white below with only a small spot of penguin blue at the tip.

A young specimen from New Zealand has an imperfect collar formed by lines of dark brown feathers which cross the throat. The bill is shorter and rounder, not flattened on the sides or so deep as in the adults. At a still earlier period, when the true feathers begin to replace the down, there are no tail feathers. These are grown subsequently, though very short, and are thicker and stiffer in some specimens than in others. The longest and thickest shanked feathers occur in the young specimen from New Zealand, described above. There are only one or two scutella on the toes at the bases of the nails.

One, U. S. Ex. Ex., Capt. Wilkes, young. One, Soc. Coll., still in the down. Australia. One, Soc. Coll., adult. One, La Fresnaye Coll., adult. All from New Zealand.

**Spheniscus demersus** Schlegel.

*Spheniscus nævius* Brisson, Ornith., 1760, vol. VI, p. 99, pl. 9. Black-footed Penguin, Edwards, vol. II. pl. 94.

*Aptenodytes magellanicus* Forst., Commt. Gotting., vol. III, p. 143, pl. 5.

*Diomedea demersa* Linn., Syst. Nat., 1758, Ed. 10, p. 132.

*Spheniscus demersus* Schlegel, Mus. des Pays Bas, 1867, Urinatores, p. 10.

A fine figure of a still younger stage, if *Spheniscus demersus* is

really the young, is given by Ed., pl. 94. This has nearly a complete head of brown. The stripes that occupy the sides of the head are merely indicated by lighter areas on the cheeks.

The young of this species in our collection has the typical characteristics of *S. demersus*, and its companion *S. magellanicus*, has, as previously noted, a complete collar of dark feathers around the neck. The *S. magellanicus* is much the larger bird. In both, the light bar crosses the bill.

The young bird is quite dark under the wing and under the tail, while the old bird has only scattered black feathers forming minute spots under the wings, and is entirely white under the tail.

One fact seems to militate against the supposition that *S. demersus* is the young of *S. magellanicus*. The tail feathers of the former in our collection are much longer and stiffer than those of *Spheniscus magellanicus*, which hardly differ from the feathers of the back. This is a feature of more or less variability, but it is usually the product of mature growth and creates a doubt which can only be answered by the examination of other specimens of *S. magellanicus*.

On the middle and outer toes there are four or five scutella upon each of the first two joints, with hexagonal reticulations upon the joint itself. The inner first joint is wholly scutellate.

One *S. demersus*, young, Cape Good Hope, La Fresnaye. One *S. magellanicus*, U. S. Ex. Exp., Capt. Wilkes, Tierra del Fuego, adult.

### PYGOSCELIS.

**Pygoscelis papua** Wagl.

*Aptenodytes papua* Forst., Comment. Soc. Gotting., 1781, vol. 3, p. 140, pl. 3. Vieillot, Galerie, pl. 299. Gray, Erebus and Terror, pl. 25.

*Aptenodytes tæniata* Peale, U. S. Ex. Exp., Peale Mss. 1848.

*Eudyptes papua* Cassin, U. S. Ex. Exp. (from Peale Mss.), 1859, p. 350.

*Pygoscelis Wagleri* Sclater, Proc. Zool. Soc., London, 1860, p. 390.

The maxilla is black down to the lateral channels, and has the tomial parts and mandible, except the tip, yellow. On the under side of the wing the upper edge is dark colored for about one-fourth of its length and the tip is also dark.

One adult. Coll. La Fresnaye.[1]

[1] The locality given is "New Guinea," and probably therefore erroneous.

**Pygoscelis antarctica** Bon.

*Aptenodytes antarcticus* Forst., Comment. Soc. Gotting., vol. 3, p. 141, pl. 4.

*Eudyptes antarctica* Gray, Erebus and Terror, pl. 26.

*Pygoscelis antarctica* Bon. Schlegel, Mus. des Pays Bas, Urinatores, p. 5.

The first joint is scutellate. Two-thirds of the upper edge and tip of the underside of the wing are dark colored.

One adult. No locality. Coll. La Fresnaye.

**Pygoscelis adeliæ.**

*Catarractes adeliæ* Homb. et Jacq., Ann. Sci. Nat., 1841, p. 320.

*Dasyrhamphus adeliæ* Homb. et Jacq., Voy. au Pole Sud, Oiseaux, pl. 33.

*Pygoscelis brevirostris* Gray, Erebus and Terror, Birds, pl. 28.

*Aptenodytes longicaudata* Peale, U. S. Ex. Exp. Mss. 1848.

*Eudyptes adeliæ* Cassin, U. S. Ex. Exp. (from Peale's Mss.), Mam. and Ornith., 1859, p. 350.

*Dasyrhamphus Herculis* Finsch, Proc. Zool. Soc., 1870, p. 322, pl. 25. Young with white throat; *fide* Coues, *in epist.*

The length of the legs in the stuffed skin of this species, has led me to suggest, that observations on recent specimens determining the length of legs might prove of considerable interest and value. There are only four or five scutella on the first joint of each toe.

One adult. Antarctic Ocean.

## Eudyptes.

**Eudyptes chrysolopha** Brandt.

*Eudyptes chrysolophus* Brandt, Bull. Acad. St. Petersburg, vol. 2, 1837, p. 314.

*Eudyptes chrysocoma* Gould, Birds of Australia, vol. 7, pl. 83.

There are only two or three scutella on the first joint of each toe. Three-fourths of the upper edge, the tip and a portion of the lower margin of the under side of the wing are dark. The dark feathers extend downward on the throat and have a concave outline. All the feathers on the top of the head are long and help to form the crest.

One adult. Falkland Islands, Coll. La Fresnaye.

**Eudyptes catarractes.**

*Aptenodytes catarractes,* Gmelin, p. 558. Forst., Comment. Soc. Gotting., vol. 3, p. 145.

*Catarractes demersus* Brisson, Ornithol., vol. 6, p. 112.

*Phaëton demersus* Linn., Ed. x, p. 135.

There may be three or four scutella on each toe. All of the upper edge, the tip and part of the lower edge of the under wing dark colored. The dark feathers do not extend upon the throat but form a nearly straight line across. On one side the dark feathers of the sides of the neck encroach upon the white of the abdomen and form a partial collar of white which is not seen on the other side. Only the lateral feathers of the oral regions are sufficiently lengthened to form the crest, and they do not extend forwards above the eyes.

One adult. Falkland Islands, Coll. La Fresnaye.

**Eudyptes chrysocoma.**

*Aptenodytes chrysocoma* Forst. Comment. Gott., vol. III, 1781, p. 135, pl. 1.

*Eudyptes pachyrhynchus* Gray, Gen. of Birds, vol. III, pl. 176.

? *Eudyptes nigrivestis* Gould, P. Z. S., 1860, 418.

Three scutella on each toe. Two-thirds of the upper edge and the tip alone of the under wing are dark. The dark feathers extend farther down upon the throat than in either of the two species mentioned and have a pointed, convex outline. The lateral feathers of the oral regions form a double crest as in *Eudyptes catarractes*, but also extend forwards beyond the eyes and join on the front to form a central tuft.

One adult. No locality, Coll. La Fresnaye.

### OSTEOLOGICAL NOTES, BY DR. ELLIOTT COUES.

The skeleton of the Spheniscidæ is highly characteristic. With the general conformation, as a whole, of that of other Pygopodes, seen in the backward set of the posterior limbs, the great extent of the bony (costal and sternal) framework enclosing the abdominal as well as thoracic viscera, etc., there are many special modifications of the skeleton, any one of a large number of individual bones being of itself diagnostic of the family. A remarkable solidity, breadth and flatness of different bones is the dominant characteristic; it marks several bones that are cylindrical in all other birds and hollow in most.

Foremost among the diagnostic skeletal characters of the family comes the partly confluent condition of the metatarsals, which in all other existing birds are completely fused. The compound metatarsus is exceptionally broad from side to side, and shows its composition in the two lengthened fenestræ that indicate the three original meta-

tarsals. This may afford a useful hint in any search for the ancestral stock or primitive type of the Spheniscidæ. As well as we can gather from the isolated fossil data at our service, birds have gradually coalesced both metacarpals and metatarsals that were free in a primitive condition. The metacarpals appear to have run together later than the metatarsals; for nearly all birds to-day show partial separation of the former, while the latter are confluent in all but the Spheniscidæ; while the oldest known bird, *Archæopteryx macrurus*, with confluent metatarsals, shows unanchylosed metacarpals, as well as two unguiculate digits on the radial side of the manus, a condition only elsewhere found in Struthio and Rhea. Reasoning upon this, we may infer that, *cæteris paribus*, the existing species of Spheniscidæ with the broadest and most largely fenestrated metatarsus, comes nearest the original stock, from which the several genera have been differentiated in the process of derivation.

The sternum likewise is positively diagnostic. To general pygopodous features, it adds a special configuration not found outside the family. The postero-external angles each send off a long slender apophysis that runs backward beyond the termination of the sternal body, and curves mesiad, approximating, at the end, to its fellow of the opposite side. There is a deep emargination between each apophysis and the rather narrow but blunt median extremity of the bone. Each one of the four families of Pygopodes shows a different modification of the posterior border of the sternum; comparing which, we may infer that in a very early condition, the sternum of Spheniscidæ extended solidly as far as these apophyses now reach. In Uria for example, which has a relatively much longer sternum the posterior border is rounded and continuous, with only indications of the apophyses in two small fenestræ; in Colymbus, also with a long sternum, the median portion is very long and broad, and separated from the much shorter apophyses by a wide emargination; in Podiceps, with a shorter sternum, the median portion is abrupt, with a reëntrance, and separated from the longer, broad and clavate apophyses by a very narrow emargination — little more than a fenestration. And in view of the fact that lengths of apophyses and of sternum proper seem somewhat complementary, it would appear that these long apophyses of Spheniscidæ have remained in partial compensation for the abbreviation of the sternum that has taken place. This would be the more probable, if the longest sternum, relatively, should be found coexistent with the greatest fenestration of the metatarsus.

The shoulder-girdle is not less diagnostic in the expansion of the scapula, which is irregularly clubbed and almost spatulate. The clavicles are very broad, flat from side to side, and strongly curved backward and downward. The coracoid is long and strong, less conspicuously flattened, and developes an apophysis at the sternal extremity on the mesiad side.

All the bones of the anterior extremity are flattened, and the distal end of the laminar humerus has an oblique truncated articular surface — a condition only elsewhere seen in *Alca impennis*. There is no free radial digit — a state of things that might have been inferred from the pterylosis of the wing. The wrist preserves two free carpals, as usual, but the ulnare has an immense laminar expansion, not found outside this family. The elbow has two sesamoids (a feature shared, however, by the Guillemots), interesting in relation to the unusually large patella, which in these birds ossifies from two centres (Owen). There is a persistent, free ossicle in the ankle of Aptenodytes, apparently a sesamoid[1]; this is peculiar, so far as I know. The tibia is very long, but not specially remarkable; it does not develope the long apophysis of the *Colymbidæ*. The pelvico-sacral connections are said to be looser than in other birds. Notwithstanding the small size and sessile and elevated condition of the hallux, this has two bones, as usual, besides the accessory metatarsal; and the phalanges of the other digits are of normal number (3–4–5, from inner to outer anterior toe). The ribs have articulated accessory processes. The bodies of the hinder dorsal vertebræ are strongly compressed with median hypapophyses; the anterior dorsals have broad divergent laminar parapophyses in Aptenodytes, and most of the dorsals are opisthocœlian (Owen). The palate has the schizognathous structure; there are no basipterygoid processes, and the pterygoids share the flattening that marks so many other bones. In its general configuration, and many minor details of structure, the skull shows three, if not four, strongly marked patterns, corresponding with and incontestably substantiating three, at least, of the genera that Prof. Hyatt has successfully established upon external characters. No one has hitherto shown us what groups are probably generic, and what are purely arbitrary.

[1] Certainly not a true tarsal ossicle, if the tarsus of *Spheniscidæ* agrees in development and structure with that of other birds; but this remains to be seen. *Cf.* Morse's beautiful and invaluable researches into the carpus and tarsus of birds. Ann. Lyc. Nat. Hist., N. Y., 1871.

Dr. B. Joy Jeffries made a brief verbal communication on the unity of design in the eyes of man and the lower animals.

In the Harvard University Course of Lectures on the "Anatomy and Physiology of Vision," which I am now delivering at Cambridge, I have had occasion to especially study the unity of design in the visual organs of man and other animals, and by means of my pictures and diagrams I trust to make this evident to the Society. As every illuminated point in nature sends out rays of light in all directions, we have only diverging rays, or those, which so far as the eye is concerned, are practically parallel. There is needed a refractive medium therefore, to bring such rays to a focus on the recipient surface, where the stimulus of light finally causes nerve stimulation, sending the sensation of light through an optic nerve to the brain or its representative. We may take the human eye as the highest type, and here we have refracting media; namely, the convex cornea and double convex crystalline lens behind it, by means of which diverging or parallel rays of light are focussed on the recipient surface or retina, which lines the interior of the eye-ball behind. Thus is formed what exactly corresponds to a *camera obscura*. We have refracting media in whose focus, or in the plane of whose focus, is placed a recipient surface, which recipient surface or membrane or retina contains the means or apparatus for causing the stimulus of light to give rise to a nerve sensation to be transmitted to the brain. Now all eyes, no matter what their external shape or appearance, if they answer these postulates may of course be ranked together as constructed on one design or plan. If we follow down the series of vertebrates we shall find these eyes all formed on this principle of the camera obscura. So also in the *simple* or *additional* eyes of the rest of the animal kingdom, we shall find a refractive apparatus, in the plane of whose focus is a recipient membrane or retina. And this notwithstanding any difference in shape, size, or general appearance of the vertebrate eye, or the simplicity of these so-called additional eyes of the insects. The only other form of eye existing in the animal series is the *compound* or *facetted* eye of the articulates. The common cornea of this eye is divided up into a large number of distinct facets, (five to thirty thousand), each one corresponding to a tube of pigment, so to speak, in which is found the final termination of the optic nerve fibre. The ray of light which enters through any one of the transparent facets can only affect the optic nerve fibre termination corre-

sponding to it. Hence naturalists and philosophers seemed forced to accord to this form of visual apparatus a different method of perceiving light from that which prevails with the eyes formed on the principle of the camera obscura. Johannes Müller's dictum, more than anything else, seemed to render this an accepted truth. Long ago, however, the strangeness was pointed out, of an animal having eyes near each other, whose methods of receiving and perceiving light were on two entirely different plans. Mr. Darwin saw at once this would militate against his theory, and comparatively recent research shows that it is not true. These compound or facetted eyes are also now found to have a refracting medium, in the plane of whose focus is a recipient surface corresponding to a retina. Each one of these facets is in reality a convex lens, and as an old anatomist said, "if we look at a man through these we shall see a whole army of dwarfs." There is, then, a picture formed behind them, just as there is a picture formed on the retina in the vertebrate eye. Moreover, behind each facet there is a refracting body which we will call the vitreous cone, and however its shape and appearance may vary in insects and crustaceans, yet its purpose remains the same; namely, that of refracting the light, and together with the convex facet focussing it on the terminal end of the optic nerve fibre behind and in contact with the vitreous cone. Here, then, the stimulus of light produces excitation of a nerve to carry sensation to the brain, or its representative. The facet may represent the human cornea, the refracting vitreous cone next behind it, the crystalline lens, and if we should push back the final optic nerve termini by the interposition of a vitreous humor, the very shape would then resemble the vertebrate type. Thus, we find unity of design in all eyes, vertebrate, simple and compound. The question naturally arises, how can the insect see things singly if thousand of pictures of the same thing are perceived. The answer is that a single fibre supplies many facets. Moreover, eyes seemingly facetted or compound, are on examination, found to be groups of simple eyes close together. No objection has been made to an animal's seeing singly with several simple eyes, when these are closely grouped, or to man's single vision with two eyes. A multiplied picture does not go as such to the brain.

Now then, where does light become turned into nerve stimulation? This takes place in the retina, for the optic nerve itself is insensible to light, and where it enters the eyeball is a blind spot in our field of

vision. The retina is by no means simply a membranous expansion of nerve substance, but a most complicated structure. Without dwelling upon the arguments in proof, I would simply say that its outer layer contains alone the percipient elements, called from their shape the rods and cones. These stand crowded together after the manner of a mosaic, at right angles to the black pigmented surface against which they lie, or rather in which they are bedded. The outer portion of these wonderfully minute little rods and cones is now found to be composed of a pile of plates of a refracting material separated by a less refractive intermediate substance, like a pile of glass plates separated by air. In contact with these come the ultimate fibrillæ of the optic nerve fibres, and in some way the action of the light streaming through this pile of plates stimulates the nerve to a sensation of light to go to the brain. This plated or layered structure of the rods and cones is universal in the vertebrate eye. The portion of the compound or facetted eye which corresponds to the rods and cones is the nerve substance, or its representative, behind the vitreous cone in the pigmented tube, and here also this plate structure has been found in the insects and crustaceans. Thus, then, not only are all eyes so formed as to be adapted to the same laws of light, in having refracting media, in the plane of whose focus a recipient organ turns light into nerve sensation, but the *percipient elements* of this receptive organ, the retina, are also the same, perfectly establishing the unity of design in all visual organs of men and lower animals.

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## Notice of an Undescribed Form of Pleurosigma; Family Diatomaceæ. By Prof. Arthur Mead Edwards, New York.[1]

With no wish to add another synonym to the already long lists which burden our overcrowded botanies, but simply with the desire of bringing to the notice of such biologists as are students of the Diatomaceæ, what I presume to be new, or, at least, unpublished, I venture to describe, and at the same time attach a provisional name to, a form of plant belonging to the family mentioned, and genus *Pleurosigma* of W. Smith, which I discovered some years since in a gathering I made at that time in a salt marsh situated near, and bordering, Coney Island, one of the small islets lying upon the ocean side of Long Island, New York.

[1] This paper was presented April 5th, 1871.

This form, as its general contour and characters plainly indicate, belongs, as I have said, to the genus *Gyrosigma*, which Hassall founded for the reception of the sigmoid forms hitherto included in Ehrenberg's genus *Navicula*, from which he thus very properly, as has been since proved, separated them. Subsequently to Hassall's division of the genus in this manner, W. Smith bestowed the name *Pleurosigma* upon the same group, and this last designation is the one most commonly in use at the present time to distinguish this genus.

I must here be permitted to make a few remarks in connection with the subject of nomenclature, as at the present time in use by writers when treating of this family of vegetable organisms. It does not appear to be generally known to such persons that certain rules of nomenclature, to be used when describing or speaking of natural objects, and more especially animals and plants, have been devised, and from their plainly apparent rationality and admirable applicability, adopted very generally by biologists in all countries. It would be extremely advisable, therefore, for all students of the Diatomaceæ, before venturing into print, to make themselves thoroughly acquainted with these rules, and to frame their publications thereon. One of these rules strongly deprecates the giving of new names to groups of natural objects, as plants or animals, which have already had designations applied to them, accompanied by sufficiently distinctive descriptions to admit of their recognition at any future time, at the fancy of any new observer, or for other insufficient reasons. The rule itself is briefly stated thus: "Names given to species or groups unaccompanied by published characteristic descriptions, should yield place to the earliest name accompanying such descriptions."

To prevent mistakes occurring in biological nomenclature, of course great care is required, and considerable research necessary. In fact, it can hardly be denied that it would be much better if, as a general rule, students, before bestowing a name on a form new to them and apparently separable on good grounds from some already established group, would even rather tend to err upon the one side than the other; that is to say, permit the retention of a name already published, but unaccompanied by a sufficiently distinctive description, if they can nevertheless satisfy themselves that the form they have under examination is without doubt that previously named. Such a conclusion can, of course, most surely be arrived at by the examination of authentic specimens, but sometimes, also, although not in so

satisfactory a manner, by reference to plates. Thus in the case of many of Ehrenberg's species, the descriptions are often so inaccurate that the student can hardly tell what that author means, and must be excused, if thereafter it should be discovered he has redescribed and renamed any of them. And this is more particularly the case with such forms as he examined in the recent condition. With his fossil species, however, in most cases there is not so much difficulty of identification, as it is but necessary to obtain a portion of the same deposit as he has examined, and in many instances there is no very great difficulty in so doing, and there can generally be detected any form on which he has bestowed a particular appellation. Thereafter, it lies with the careful student to determine if the species be good or not; and he can satisfy his mind as to whether the name given to it should be retained. Unfortunately, however, Ehrenberg has occasionally bestowed the same name on two, or even more, totally different species, or, what is quite as bad, if not worse, given two or more names at different times to the same species. In truth, the otherwise great value that would have attached to his contributions to this branch of knowledge, is very materially lessened by these facts, and students are compelled either to stretch their consciences to their utmost capacity, or to ignore altogether what he has done in many directions. I instance Ehrenberg, as he has bestowed names upon a much larger number of forms than any other observer, and was almost the first to call attention to the beauty of structure exhibited in the siliceous epidermes of these remarkable plants. Many of the errors he has fallen into have, however, plainly occurred from the defective instruments of research at his command, at the time his investigations were made. Some of our later students have, nevertheless, at times, fallen into equal error, and in their case there is not so much excuse; for the rule above quoted, and which seems to be so very sensible upon the face of it, has not been even taken into consideration by those who appear otherwise to be very careful investigators. One example in illustration will suffice. Thus, on examining W. Smith's very elaborate and beautifully illustrated Synopsis of the British Diatomaceæ, we find him naming a species of the genus *Epithemia* as *Argus*, acknowledging at the same time that it had been previously described as *Epithemia alpestris* by Kützing; ignoring entirely that already established name, for no sufficient reason, but apparently because he, Smith, wished to apply the name *Alpestris* to what he considered a new form he had discovered. The confusion

naturally resulting, and the obstruction to the progress of knowledge that would eventuate from such a mode of proceeding, is at once apparent, and plainly points to the wisdom of the rule alluded to above.

No doubt an ignorance of the recognized rules of nomenclature is, in some cases, the cause of this mode of procedure, but a desire to see one's name in print, tacked on to a species as its discoverer, is also, and it is to be feared oftener, the real reason why our botanies are loaded down with hundreds of confusing and avoidable synonyms. Therefore it is with the desire that the nomenclature adopted when describing and naming the Diatomaceæ, should be made as much as possible to conform to set rules, that I call the attention of students to the fact that Hassall was the first to separate the sigmoid forms from the genus *Navicula*, and to found a new genus for their reception. This genus he named *Gyrosigma*. De Brébisson objected to the adoption of this name on tautological grounds, and his objection has been acquiesced in by others, who have, in consequence, rejected Hassall's designation and adopted that applied to the group by Smith, *Pleurosigma*.

It is not my wish in this short note to in any way urge the re-adoption of the name *Gyrosigma*, but I take the opportunity of calling the attention of students to a point in connection with the Diatomaceæ, on which time could be well spent, and would, it is plain, yield to the conscientious worker very profitable returns. It is my intention to do something myself, as opportunity offers, in endeavoring to clear up some points in the synonomy of these plants, and I hope for assistance in the shape of specimens, from collectors in all parts of the world. To that end, I have prepared printed directions for collecting and transporting gatherings, and these will be sent to any one desirous of contributing to the end in view.

Another point I would wish to say a few words on, and that is, to enter my protest against the absurd habit of biologists, of giving the description of species and similar groups in a foreign, dead language, although the body of their paper may be in their native tongue. No one can write any better in a language which is foreign to him than in his own, and certainly not when the language is a dead one. Descriptions of groups of natural objects should be as clear and concise as possible, and this an observer can do best in the language he has been most accustomed to. Therefore, I shall always give my descriptions in such English as I am master of, trusting to the ability of foreign observers to translate them into their vernacular.

The form I wish at the present time to describe, is of a brackish or perhaps salt water habit, as it was found in the living state associated with both brackish and salt water species, and in a part of the marsh at times open to the water of the ocean. Although I bestow a name upon it, I wish it to be distinctly understood that I do not therefore claim that it is a new species, but apply the name to it merely to distinguish it, so that hereafter as it is better known it may be referred to and correctly placed. At the same time, I must say that I am strongly of opinion that it will be found on careful examination to be as good a species as most of those at the present time included in the genus. It is allied to *Pleurosigma Baltica*, of Ehrenberg; that is to say, the markings upon the valve are of the same character; being so arranged as to make it appear as if the valve were covered with darkish lines running at right angles to each other, and in general, parallel and transverse to the median line. In outline it is closely allied to *P. speciosum* of W. Smith, but is much shorter on S. V., in proportion to its width, than that species. The characters of this form are briefly as follows:

**Pleurosigma robustum.**

F. V. linear. S. V. linear-lanceolate, strongly obtuse, flexure very slight, ends blunt, sides parallel for about one-third of the length.

Length, .115 m. m. Width of valve, .03 m. m. Markings apparently consisting of parallel lines crossing each other at right angles, 14 in. .001 m. m.

Habitat, brackish or salt water.

Locality, Coney Island, Long Island, New York, Sept. 27, 1862.

P. S. Since the above was written I have found the same form, although still not common, and mixed with various others, growing in the form of a fawn-colored stain upon the sand of the sea shore at Coney Island. Several beautiful forms were obtained by washing the sand thus colored, and they would seem, for the most part, to be identical with those Dr. Donkin obtained in the same way some years since on the coast of Northumberland, England.

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## Section of Entomology. May 24, 1871.

Mr. P. S. Sprague in the chair. Nine members present.

Mr. Sanborn described a simple method of preparing the skins of caterpillars for the collection. First puncture the

skin of the caterpillar at the anus, tearing away the internal membranes from their attachment at that part; the larva is then placed on a piece of blotting paper, and rolled out with a lead pencil from the head backwards, the contents of the body being thus expelled. A fine tube is then to be inserted in the anal puncture and confined there by thread. A sand-bath is to be made, consisting of an argand chimney or similar tube inserted in a larger metal cylinder of the size of a tomato can and the intervening space filled with hot sand. This apparatus may be placed upon a hot stove or above a lamp or gas jet. Thus the inside of the chimney forms a hot-bath, in which the skin of the caterpillar, tied to the tube, is thrust; the empty skin is now to be inflated by the breath, and frequently revolved, continuing the inflation until it is perfectly dry. The skin so prepared may be pinned and placed in the cabinet.

Mr. W. H. Dale presented over fifty pinned specimens of insects collected by him in Florida.

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June 7, 1871.

Vice President R. C. Greenleaf in the chair. Twenty-two persons present.

Dr. T. M. Brewer presented the following paper: —

## On the Physical Geography and Natural History of the Islands of the Tres Marias and of Socorro, off the Western Coast of Mexico. By Col. Andrew J. Grayson. Edited by Geo. N. Lawrence.

In a paper published in the Annals of the Lyceum of Natural History of New York, Vol. x, Feb., 1871, I stated that it was my intention to publish a catalogue of all Col. Grayson's collections made in Northwestern Mexico, together with those of some others. Since then it has been thought best to give separate lists of the birds

obtained by Col. Grayson at the Tres Marias Islands and the Island of Socorro.

With the other papers sent me by Prof. Henry, are the narratives of Col. Grayson's visits to these Islands, which I have permission to print with the lists of birds. Little is known or published concerning these Islands, and as they are seldom visited by persons of intelligence, the information given by so accurate an observer as Col. Grayson will be found not only entertaining but instructive. Besides ordinary incidents, observations of the physical features of the Islands, interspersed with remarks upon their natural history, are related in a very attractive and pleasing style.

Col. Grayson made three voyages to the Tres Marias, in 1865, 1866 and 1867, and visited Socorro twice, the last time in 1867.

In April, 1869, Col. Grayson made a voyage to the Isabel Islands for the purpose of studying their natural history, but unfortunately while there he contracted a fever, which terminated his useful life in August, after an illness of about three months.

An interesting account of the principal incidents of Col. Grayson's life is given in the *Overland Monthly* of Feb., 1870.

In making the exploration of these Islands to ascertain their natural history, Col. Grayson was aided by contributions of funds from the Smithsonian Institution and the Boston Society of Natural History.

All the material from Col. Grayson's papers is indicated by inverted commas.

"This beautiful group of Islands, forming the subject of the present article, is situated about seventy miles west of San Blas, and about ninety or one hundred miles south of Mazatlan, in lat. 21½° north, and long. 106½° west. They are respectively named, Maria Madre, the northern and largest; Maria Magdaléna, the middle, and second in size; Cleafa, the most southern, and smaller; and also San Juanito, which is the smallest, lying at the northwest extremity of Maria Madre. Deep and narrow passages separate them all, except San Juanito, which is connected with Maria Madre by soundings of no great depth. They range nearly southeast and northwest. With the exception of the haçienda of Don Andres Somilara, to whom the Island of Maria Madre has been leased by the original grantee, they are entirely uninhabited.

"This haçienda, consisting of a few rude huts for the laborers, and a larger one for the Mayordomo, is situated on the east side of Maria

Madre, and has been but recently established for the purpose of cutting and shipping the fine timber there abounding, as well as for the cultivation of cotton and other products.

"To these Islands I had long contemplated a visit, and at length an opportunity offering, I sailed from the port of Mazatlan, on the third day of January, 1865, with a friend, upon a very small schooner of only fifteen tons. Imagine our discomfiture when we found her decks crowded with thirty persons, all Mexicans, men, women and children, together with the little worthless dogs which always accompany the lower class of natives wherever they go. They were bound to San Blas, the vessel only touching at the Islands to discharge some provisions for Don Andres. We started with a fair breeze from northwest, which is the usual, or trade, wind of this season.

"The following morning was delightfully clear and calm, and the sea remarkably tranquil. The Islands appeared in sight in the distance, as if rising from the sea, like phantom clouds, and the scene was enlivened by numerous sea birds sailing lazily over the water, or resting in large flocks upon its glassy bosom. Large turtles lay sleeping upon the calm surface, and upon the back of each, a bird of the gannet species was standing like a sentinel.

"A turtle was harpooned by one of the crew, as it lay immediately in our track, and soup for all who had an appetite was served from the captured prize. Large flocks of sea plover[1] were flying over and lighting upon the sea, busy feeding upon the animalculæ or diminutive shells floating on the surface. I regretted that it was out of my power to secure specimens of these birds, as having seen them frequently before when the sea was calm and always far from land, I wished to know them better; but we had not a small boat to go after them if shot. Gannets were quite abundant following a school of porpoises. A few gulls and terns were flying about, also the dusky petrel, which is always common in these latitudes.

"As the day advanced we gradually neared the Islands, and their magnificent forests were slowly unfolded to view, the ever green foliage extending to the water's edge and densely covering hill and vale. About sunset, we anchored in calm water, in a crescent shaped nook, a cable's length from the shore, fronting the small settlement of the timber cutters; a canoe came out to us and in it we went ashore, happy to be released from the miserable craft and crowd in which

[1] Prof. Baird suggests that these were probably Phalaropes (*P. fulicarius*.) *Ed.*

convenience or comfort was out of the question. We landed without difficulty, (there being no surf), upon a beautiful shingly beach, over which was scattered shells and snow-white coral in profusion. We were received with a considerable degree of suspicion on the part of the proprietor, Don Andres Somilara, and it took some time to satisfy him of the object of my visit. He may justly be called Lord of the Isle, being the pioneer to this primitive region.

"Maria Madre is about fifteen miles in length, by ten or twelve in width. At the extreme southern end there is a salt pond yielding an abundance of salt for exportation, but at present no attention is paid to it. The salt is crystallized or formed by the flow and ebb of the tide, which filters through a narrow sand ridge dividing it from the sea. The pond, which is clean and free from brush and weeds, is about three-fourths of a mile long and a hundred and fifty yards wide. Maria Magdeléna is twelve miles in length and nine or ten in width; it is unoccupied and covered with a grand forest of fine timber. The immense cedar (*Cedrela odorata*) grows in great abundance on this island, not having been disturbed by the wood cutters. This tree makes the finest lumber in the world. It is also common to the coast of Tierra Caliente. Cleofa, the smallest of the three islands, is also well wooded and has a good little port. All these islands, except Juanito, are covered with a dense forest from the water's edge to the top of the highest hills. The shape of the trees (of which there is a great variety), is generally straight or straighter and taller than upon the main. There is but little thorny underbrush, so characteristic of the Tierra Caliente.

"The morning of the 6th was bright, the air soft and balmy. As I entered the magnificent forest upon the duties of my mission, it was with no little pleasure I found the woods well supplied with birds, and noticed their remarkable docility. Many of the species were familiar to me, others entire strangers. I was surprised to find some of the species common to the main land, so tame as to be easily taken by the boys with a running noose upon the end of a rod or pole, whilst upon the main they are difficult to approach within gun shot. With but one or two exceptions the birds on these Islands are very tame, and look with but little concern upon the intruder in their shady retreats. Another fact worthy of note is that they are all very fat, so much so as to render the preparation and preservation of the specimens difficult. The papers in which they are enveloped become saturated with oil, while the skins were being dried.

The abundance of food that the insectivorous birds find among the vast amount of decaying logs and branches, which harbor innumerable coleoptera and their larvæ, is one cause of their fatness; another is their freedom from molestation by man, and the various species of hawks and other animals of a ravenous nature, which keep them in a constant state of watchfulness on the main shore. If these islands are interesting to the ornithologist, they would be equally so to the botanist and geologist.

"The giant cactus (*Cereus giganteus*) grows here to an enormous size, and seems to vie with tall trees among which it is found. The dark higuera (*Ficus Americanus*) spreads its immense branches, upheld by the roots sent to earth to support them, giving the tree the appearance of the famous banyan.

"The stupendous cedar (*Cedrela odorata*) with its rough bark and pinnated leaves, its huge branches overgrown with curious orchids, is king of the woods, and resembles in its outward form the black walnut.

"The Palo prieto, with its smooth green bark, its tall and straight trunk crowned with fresh looking and evergreen foliage, together with the hardness and durability of its wood, is one of the most beautiful, as well as useful trees of the forest. Here too, the gigantic silk cotton tree (*Eriodendron anfractuosum*) with its spheroid pods suspended to its wide spreading branches, is conspicuous. Various other handsome and strange trees interlaced and festooned with the innumerable lianes and creepers, among which the wild hop is most abundant, overshadowing the earth, give to the forest a dark and wild aspect. Scattered through the woods is a species of maguey that exceeds in size any plant of the kind ever seen by me, their long, spear-shaped leaves measuring six to eight feet in length, the head or stalk proportionally large. When in flower, the flower stem reaches to the height of forty or fifty feet, where it branches off like a candelabra. It blooms once in seven years, and then dies. There is a great abundance of this plant growing in certain localities. The San Juanito is partly covered by it. The palms are not represented in the islands, while upon the near coast, below San Blas, they are abundant, particularly the Palma Real.

"Here are hundreds of plants to interest the botanist, many of which I am certain are new. I found the true wild cotton, not growing as a tree, but a plant laden with small bolls or pods, containing a very silky yellowish fibre, and black seed. The bolls were not

well opened, but it is doubtless of the same species from which the cultivated cotton has been originally obtained. Wild tomatoes and capsicum are found growing in the woods.

"The physical and geological structure is strange and peculiar, especially so, as differing from any other formation found upon the coast.

"The indications and unmistakable evidences we read upon their surface lead us to the conclusion that the materials of which they are composed once lay at the bottom of the sea, and have been raised to their present form, at some period of the earth's history, and perhaps subsequent to the elevation of the adjacent region composing the main land.

"The stratified formation appears to be horizontal, and but little broken or disturbed, throughout the Island of Maria Madre. The strata are well defined, particularly where there is a precipitous bank or cliff exposing them to view. The composition of these layers is various. The most common is a conglomeration of sea mud and gravel, in which vast quantities of fossil shells and coral are mingled. Some consist entirely of soft sandstone, while in others lime and chalk are found. Large boulders, lying detached and scattered about over the surface, have the appearance of granite, but upon near inspection prove to be solid blocks of coral formation, which, where they are gradually becoming decomposed, are soft and easily broken. Vast masses of fossil shells, cemented compactly together, form in many places the upper strata. Many of them appeared identical with fresh shells found upon the shore.

"I discovered no indications of volcanic phenomena. Pumice stone is found in some localities near the beach, but its rounded and water-worn appearance shows it to have been drifted there by the waves of the ocean. In fact the regularity of the strata and the general physiognomy, especially of the largest island, shows that they probably have not been subject to any remarkable convulsions.

"The island of Socorro, about two hundred and forty miles west of the Marias, which is about thirty miles in length and fifteen in width, presents a very different aspect. Its formation is entirely volcanic and its strata tilted and thrown into every position, and its high and peaked mountains prove it to have undergone severe convulsions.

"But the Tres Marias seem to have risen gently and gradually from the sea, nearly in the shape they now present, with the exception of the ravines and creek beds formed by the natural courses of

the water from copious rains. In ascending the elevated plateau upon the northern and southern end of Maria Madre from the sea shore, we find the country to be as flat as a table for several miles in extent, covered with large trees and rank vegetation. This horizontal formation of the underlying strata retains the moisture in the earth throughout the dry season. It is my opinion, from various indications, that bituminous coal exists in this island.

"Good water is found by sinking a well fifteen or twenty feet. In the latter part of the dry season, I saw young and tender plants growing luxuriantly. The cotton and tobacco planted by Don Andres continued fresh and green throughout the dry season, and of very large growth, also melons, squashes, beans, etc., without irrigation. The shelly debris and vast amount of decaying vegetable matter have created an exceedingly rich and prolific soil.

"How many centuries after the islands made their appearance above ocean's waves it has taken to prepare a soil for its present form of vegetable and animal life, can only be left to conjecture or the scientific geologist to determine.

"The climate is healthy, and free from malarious influences. The usual northwest trades, which are almost constant and of moderate force, serve to cool the air, making a temperature both regular, balmy and pleasant during the year.

"In the dry season heavy dews are frequent, the drops of which I have often seen the birds sipping, for want of other means of quenching their thirst, there being but few *ojas de agua* (springs).

"Thus we see in these islands a little world, whose creation seems to be comparatively modern, and whose fauna and vegetation are in many respects peculiar to itself.

"The following list will represent the birds found upon these Islands. I include no species but those actually seen by me. In a few instances only, when I supposed the birds to be new, I have given their natural history more in detail."

## "BIRDS OF THE TRES MARIAS."

### VULTURIDÆ.

1. **Cathartes aura** (Linn.). "Turkey Buzzard; Sopilote."

"This widely distributed species is common upon the Islands, where it is a constant resident, or a visitor from the main land.

None of the *Vulturidæ* is so well known throughout Mexico and the United States as the Turkey Buzzard.

"I did not see this bird upon the Island of Socorro. Perhaps the Islands of 'The Tres Marias' form its extreme western range."

## FALCONIDÆ.

**2. Polyborus audubonii** Cass. "Caracara Eagle; Quelele."

"The Caracara Eagle, or hawk vulture, possesses the qualitis of both the hawks and the vultures, and it is rather difficult to decide by its habits and manners to which it more closely approximates. In general appearance it resembles the hawk, and although it subsists mainly on dead animals and other offal, it does sometimes capture young birds, lizards, snakes and land crabs. It generally carries its prey in its beak, but I have also seen it bearing off its food, as the hawks do, in the claw.

"It walks with facility on the ground, and I have often met with it in the thick woods, walking about in search of snakes and lizards. It is very docile, frequenting the vicinity of towns and ranches, and sometime seen in company with the Black Vulture (*Cathartes atratus*).

"The Caracara Eagle is quite abundant in the Tres Marias, which is perhaps its greatest western range."

**3. Buteo borealis** var. **montana** Nutt. "Western Red-tailed Hawk; Gavilan."

"The Western Red-tailed Hawk is quite abundant on the Islands, where it subsists almost entirely upon the Iguana lizard and rabbits, which are very numerous. I also found it in the far western Island of Socorro, situated in lat. 18° 35′, long. 111°, where I saw a pair nesting. This must be the most western boundary of its range. It is a common species in all parts of Western Mexico, and northward to the Rocky Mountains."

**4. Pandion carolinensis** (Gm.). "The Fish Hawk; Aquila pescadoro."

"I saw several individuals of this species on the Islands, a pair of which were nesting. This nest was placed upon the top of the large thorny limbs of the giant cactus."

**5. Falco peregrinus** var. **nigriceps** Cass. "The Western or Lesser Duck Hawk; Gavilan."

"I procured one specimen of this elegant species while upon the Island, which I sent to the Smithsonian Institution. When I shot it,

it was endeavoring to capture a sparrow hawk (*Falco sparverius*) and had I not stopped him with a lucky shot, the little fellow would have most probably made a breakfast for his more powerful antagonist. This is another instance which I have frequently witnessed of the indifference or impartiality shown by this hawk in the selection of the game he pursues. It attacks with vigor every thing it sees upon the wing, from the size of a mallard duck down, and is the terror of all small birds. The range of this daring falcon, like the Peregrine, must be very extensive, as it often ventures far out to sea. On a passage from Mazatlan to San Francisco, in 1858, on the bark Carlota, one of these falcons came to us, more than a hundred miles off the coast of Lower California, and took up his quarters upon the main-yard, or mast-head; it remained with us two days, during this time it captured at least a dozen dusky petrels. It was a fine sight to see him dart headlong upon these unsuspecting wanderers of the deep, seldom missing his aim; he would then return to his usual resting place and partly devour his prize. At other times he would let them drop in the sea, after they were dead, seemingly in wanton sport. He finally became tired of this kind of game, and after making several wide circles around our ship, and ascending to a considerable height, took his departure in the direction of the shores of Mexico."

6. **Tinnunculus sparverius** (Linn.). "The Sparrow Hawk; Gavilancillo."

"This common species is also found on the Tres Marias. Its geographical distribution is the entire continent of America."

7. **Hypotriorchis columbarius** (Linn.). "Pigeon Hawk; Gavilan."

"The Pigeon hawk is very common upon the Islands where it finds an abundance of small birds, pigeons, robins, etc., to satiate its appetite.

8. **Hypotriorchis rufigularis** (Daud.); (**aurantius** Temm).

"The year preceding my visit to these Islands, while in camp near the foot of the Sierra Madre mountains, not far from the mining town of Parnico, in the State of Sinaloa, I met with two small falcons, the smallest I had ever seen, which in their movements upon the wing reminded me of the Peregrine falcon. They were very small indeed, seemed to be but little larger than the large swift (*Cypselus*) found in this country, and the motions of their wings were apparently as

rapid as that of the swift. They were chasing each other in a playful manner, and while observing their graceful movements, one of them captured a small parrot from a flock which had just settled on the top of a large tree. After striking this most diminutive of the parrot species (*Psittacula*) he came to the ground with it, at the foot of the same tree. I endeavored to procure one or both these falcons, but the mountains were so steep as to render it impossible. In chasing each other, they uttered a sharp whistle as t'chee, t'chee, t'chee. One morning during my rambles on the Tres Marias, hearing this well remembered note, I commenced searching for it with great caution, and soon discovered the little fellow sitting upon a dry branch of a tall tree. Unfortunately both barrels of my gun being charged with fine shot, No. 11, I approached to the foot of the tree immediately under him to lessen the distance as much as possible, but upon firing, he darted downward through the forest (slightly wounded) with the rapidity of an arrow, his wings in rapid motion like the swift. The markings of its plumage, as far as it could be discernible at the distance from me, had the resemblance of the Peregrine. This is undoubtedly the smallest and most beautiful of the Falconidæ, a rare and perhaps but little known species. I still have hopes of again meeting with this interesting falcon with better success."

In a memorandum attached to Col. Grayson's note, Prof. Baird suggests that the hawk seen by Col. Grayson was probably *Hypotriorchis aurantius*. As one of that species was afterwards obtained at the Marias by Col. Grayson, Prof. Baird's conjecture was doubtless correct.

## STRIGIDÆ.

9. **Strix pratincola** Bp. "The Barn Owl."

"I did not see this owl on the Islands, but often heard at night its well known hissing scream. It is common throughout Mexico, as also in all temperate North America."

10. **Athene cunicularia** (Molina). "Burrowing Owl; Lechugacillo."

"A few individuals of this species inhabit the Marias Islands, perhaps wandered from the main land. While making a passage from Cape San Lucas, Lower California, to Mazatlan, one of these little owls came on board, so much fatigued as to be easily captured. This is some evidence of its migrating propensities."

## PSITTACIDÆ.

11. **Chrysotis levaillanti** Gray. "Yellow-headed Parrot; Loro."

"This large and handsome parrot is peculiar to the Islands, where it is very abundant, but is not found upon the main land in this part of the country. In the evenings they may be seen in flocks or pairs, flying very high, going to some part of the island to roost. They are so tame and unsuspecting as to be easily taken, simply by putting a running noose upon the end of a slender pole and slipping it gently over the head while it is busy feeding among the branches of the trees. They breed in the hollows of large trees like all the species. The wood cutters sell them to vessels touching there for timber, doubtless of late some of them are taken to Europe and other parts of the world."

Although this species was not found by Col. Grayson in the neighborhood of Mazatlan, it is not uncommon in southwest Mexico, at Tehuantepec, whence specimens were sent by Prof. Sumichrast; it also inhabits middle and eastern Mexico.

12. **Psittacula cyanopyga** De Souancé. "Love Bird; Catalina."

"The smallest of the parrots, and quite numerous in the Islands, where it is a constant resident. There is a closely allied species on the main land, from which the Tres Marias' variety differs in its larger size, especially of the bill, and in its deeper green color, the bill also is darker at the base, that of the main being entirely white.

"These beautiful little parrots are great favorites with every one. They become very tame and affectionate, but owing to their extreme delicacy, they do not survive long in confinement.

"Their note is rather feeble, and they never learn to utter words like some other birds of their family.

"The general appearance of the plumage is lively green, the tail short and rounded, rump in the male violet blue.

"This and the yellow headed parrot are the only two varieties inhabiting the Tres Marias."

Dr. O. Finsch (Abhand. Nat. Ver. zu Bremen, 1870, p. 353) has determined the species of Psittacula, collected at the Tres Marias, by Col. Grayson, to be *P. cyanopyga* De Souancé.

There are but two specimens from the Tres Marias, both females; these differ from those of the main land, of which there are eight of

both sexes before me, in being of a darker green, as pointed out by Col. Grayson, they are notably darker on the rump and upper tail coverts, in the others there is a greater prevalence of a yellow shade throughout the plumage; in size and the color of the bills, they do not differ materially from the two localities; perhaps the Marias bird may be considered a darker local race.

## TROGONIDÆ.

**13. Trogon ambiguus** Gould. "Western or Mexican Trogon; Coa."

"Although confident that this variety is peculiar to the Tres Marias, yet its congener upon the main land so closely resembles it, that I can scarcely perceive any specific difference in its general contour. A bird of so feeble flight, and always inhabiting a thickly wooded country, could never have passed from the main land to these Islands. Nature seems to have created it there, as those upon the main, with its magnificent plumage an ornament to the dark forest, for which it shows the greatest preference. It is more abundant in the Islands than on the main land, and more docile.

"The natives ensnare them in the same manner as the yellow headed parrot.

"With all its resplendent dress, as is characteristic of such birds, its love song is not melodious. The simple and rather hoarse repetition of coa, coa, coa, is heard in the spring of the year, and from this note it has received its name by the natives. Most of the time it is silent, remaining stationary upon the branch of a tree with its head slowly turning from side to side, obviously hunting for some insect concealed under a leaf or the fruit upon which it feeds. When such objects are descried, it darts upon it something like the Fly-catchers.

"Like the parrots, it nests in the hollows of tall trees; its flight is short and undulating.

"Description of a fresh specimen. Bill pale yellow. Bare space around the eye or eyelids red. The entire upper part of this species, with the neck and upper part of breast, are of a rich lustrous metallic, golden green, more intense on the rump, with occasionally coppery reflections, especially on the scapulars.

"The forehead, sides of head, chin and throat are dull black, with (in some lights) a greenish shade.

"The wing coverts are finely mottled black and white. The quills dark brown, with the outer webs edged with white. The entire

underparts are of a rich carmine red. The feathers with concealed white just below the red. A white, crescent shaped collar separates the green of the breast from the carmine. The outer three tail feathers are white for most of their length, and dusky towards the base, especially on the inner webs for about the terminal inch, the white is pure elsewhere, finely barred transversely or dotted with black, the two middle feathers are greenish coppery, abruptly tipped for about an inch with black, the remaining ones are similar, but with more of a violet tinge. Feet, pale brownish. Iris brown.

"The colors of females are much duller though otherwise similarly marked.

"Dimensions of the Tres Marias' bird taken fresh. ♂ Total length, 11.50; alar ext., 16.75; tail, 6 in. ♀ Total length, 12; alar ext., 16.75; tail, 7 in."

## CAPRIMULGIDÆ.

14. **Nyctidromus albicollis** (Gmel.). "Tres Marias' Night Hawk; Caballero."

"I procured specimens of this goatsucker in the Islands, where I frequently found them upon the ground beneath the shade of rank forests.

"All the birds I shot of this species were excessively fat. Its note is simple and plaintive, oft repeated throughout the night during the love season and says very distinctly caballero, caballero, whence it derives its Mexican name."

## PICIDÆ.

15. **Picus scalaris** (Wagl.). "Least Woodpecker; Carpenterocillo."

"This bird is more abundant in the Tres Marias than on the main coast, where it is also a common species. I have met with it along the Tierra Caliente bordering the Pacific coast, from Sonora to Tehuantepec. It seems to thrive better in the Marias than elsewhere, for there it is very numerous and may be seen, or its gentle tappings heard in the quiet woods at all hours of the day, busy drilling into the dried branches and logs in search of borers or white ants, upon which it becomes very fat. I found a nest (in the month of April) of a pair of these little woodpeckers, upon the Island near the sea shore, bored into the green flower stem of a large maguey

plant. The entrance of the nest was beautifully rounded, and about twelve feet from the ground. This tall, slender, smooth stem, not more than four inches in diameter, with its soft, spongy wood, afforded a convenient material to work out the nest, as well as a sure protection against the raccoon or other intruders, the long spear shaped leaves armed with spines at the root, preventing the possibility of a near approach to it from the ground without some labor of cutting them away.

"They both evinced a great deal of uneasiness at my presence. As I had no instrument however, to cut away the dagger shaped leaves of the maguey, I left them with their well fortified domicil."

## COLUMBIDÆ.

16. **Leptoptila albifrons** Bp. "The Ground Pigeon; Palomo."

"This dove seems to be identical with the species found throughout entire Western Mexico, and is very abundant in the Marias. It is commonly found upon the ground, in the thickest part of the woods; it also lays its eggs upon the ground, with but little pretension to forming a nest. It is entirely solitary in its habits, rambling about in the woods in search of various kinds of seed upon which it subsists, and occasionally uttering its peculiar coo oo rr.

"Our table was often well supplied with this delicious game. The flesh is nearly as white as that of the quail, very tender and juicy."

17. **Columba flavirostris** (Wagl.). "The Blue Pigeon; Patagonia."

"This is the largest of our pigeons, and abundant in the Marias, as well as in some localities on the main land. It is gregarious and frequents large forests, feeding upon various kinds of berries, acorns, etc., etc. It migrates from one part of the country to another in small flocks. In some seasons of the year the flesh of this bird has a bitter, disagreeable taste, caused by some species of berry or small bitter acorn upon which it subsists.

" Total length of male, 14.5; alar ext. 24 in.; tail, 5.5; tarsus, 1-5; middle to end claw, 1.5; bill, white at tip, red at base; space around the eye red; feet, purplish red.

"General appearance. Slaty blue, tinged upon the lesser wing coverts and upper part of neck and back with rufous, with slight metallic lustre, second and third primary longest;—tail slightly rounded and broad."

**18. Chamæpelia pallescens** Baird. "Little Ground Dove; Cocochita."

These birds are not very abundant in the Marias, but upon the main land they are quite common, also found at Cape San Lucas Lower California.

"On my hasty visit to Socorro Island, I saw several small doves that seemed to be of this variety, but I was unable to procure a specimen, in consequence of a short stay, and sudden departure from that Island. This species, unlike the larger ground dove, builds its nest on the low branch of a bush or cactus.

"Total length, 7 in.; alar ext., 11 in.; tail, 2.75; bill, brownish black, lighter below; iris, yellow; feet, flesh color; nails brown; tail slightly rounded."

## TURDIDÆ.

**19. Melanotis cærulescens** (Swain.). "Blue Mocking Bird; Mulato."

"One of the most abundant as well as interesting song birds of the Marias. They are tame and confiding; allowing persons to approach very near them, often following me in the woods, evincing considerable curiosity, and uttering mimicking cries, and occasionally breaking out into the richest song, awaking the echoes of the silent woods. Like the true mocking bird (*Mimus polyglottus*) this bird is solitary in his habits, showing great aversion to the companionship of its own species, and combats between them are very frequent. The notes of this bird are full and melodious; at all seasons of the year the woods are enlivened by its mellow song, and during the spring or love season, it is particularly so. They make excellent cage birds, are easily kept and soon become reconciled to their prison even when taken at an adult age.

"This bird seems to differ but little from the species on the main land.

"General appearance, dark slaty blue, lighter on the head and neck, with a black streak in front and around the eye. I have sometimes met with specimens in which some of the feathers of the wing and rump had changed to pure white, giving them a singular and unnatural pied appearance.

"I saw one that was nearly white. The black bill, which is gently curved and rather slender, is about as long as the head. ♂ Total length, 10 in.;—extent of outstretched wings, 13 in.; tail, broad, graduated or rounded, 4.5 in.

"They inhabit the densest forests and thickets, spending much of their time upon the ground, turning up the leaves with their bill in search of insects."

**20. Turdus flavirostris** Swain. "Mexican Robin; Merulin."

In general appearance this thrush resembles its allied species (*Turdus migratorius*), the common robin of the United States, and like that bird is also partly migratory in its habits. They frequent the Islands in great numbers, and become excessively fat upon the various kinds of berries which they find in abundance in the Marias. They also breed there. This bird is common on the main land, in the vicinity of Mazatlan, Tepic, Bendaras Bay, Colima and Tehuantepec.

"Prof. Baird says this species is but little known to ornithologists at the present time, none having been obtained by Boucard, Sallé DeOca and other collectors. I have sent specimens from the Marias and main land.

"Iris, reddish brown, feet brown. Total length of adult male, 9.30; alar ext., 15 in.; tail, 4 in.; tarsus, 1.15; bill, measured from forehead, .75; third primary quill longest.

"There is but little difference in the color of the sexes."

**21. Turdus grayi,** Bp. "Grey-breasted Robin, Merulin."

"Is a resident of the Tres Marias, as well as in some localities on the main shore. I procured specimens near Tepic at the beautiful haçienda of Iauja, belonging to Barron and Forbes, in the months of April and May; they were in full song then, and commencing to build their nests among the orange and mango groves that so handsomely ornament the grounds of Iauja. One was here kept in a cage and its melodious whistling notes could be heard for some distance. Their song somewhat resembles the northern robin (*Turdus migratorius*) but is more voluminous.

"The Marias and Tepic are the only localities I saw this thrush; it is however, doubtless much more widely distributed."

**22. Turdus ustulatus** Nutt. "Wood Thrush; Merulincillo."

"I found this little thrush in the month of January, quite abundant in the thickest of the woods of the Tres Marias. It is very timid and shy, more so than any bird I saw upon the Islands; it frequently uttered a low plaintive whistle, and seemed solitary in its habits. I am unable to state whether it is a constant resident upon the Islands, or only a migratory visitor.

"*Special Characteristics.* Third and fourth quill longest, (counting the spurious one); tail nearly even, or but slightly rounded. Upper

parts uniform reddish brown, with a faint olivaceous tinge; fore part of the breast tinged with a brownish yellow, becoming paler to the chin; the remaining parts are white; sides of the throat and fore part of breast, with small, distinct, triangular spots of well defined brown; sides of the breast more obsoletely spotted, and sides of body washed with olivaceous yellow-brown. Under wing coverts yellowish brown, the basal portion of the entire inner web of the secondaries pale yellow or buff. When the wings are outstretched, and particularly when the bird is in flight, this shows a broad and rather faint (although distinct) whitish band across the wing. Bill, brownish, under mandible yellow at base. Length, 7.50; wing, 3.75; tail, 3; tarsus, 1.12."

23. **Mimus polyglottus** Linn. "Mocking Bird; Censontli."

"I saw a few individuals of this interesting and well known songster, which were very shy and seemed to be lost or out of their range; perhaps wandered from the main land. This is not improbable, as during a voyage from Guaymas to Mazatlan, and midway in the Gulf, a fine male bird of this species came on board of our craft, so much fatigued as to be easily captured."

## AMPELIDÆ.

24. **Myiadestes obscurus** Lafr. "Iilguero."[1]

"In the Marias this bird is more frequently to be met with, and not so wary as on the main land; confining itself to the hilly portions of the Islands, where at all seasons its strange medley of song may be heard in the evening and morning.

"They are great favorites with the Mexicans, and we often see them in cages, in different parts of the country. They make good cage birds, and sing well, their notes, however, are very singular, reminding one of a discordant music-box.

"The general colors of this Iilguero is reddish brown on the upper parts; breast and sides pale lead color, chin and throat white, with a narrow black streak on each side of the throat, extending backward from the base of the lower mandible, about half an inch; a white ring around the eye; abdominal region and under tail coverts, white; bill, black, short, and rather depressed; feet, black; eyes black. Total length of male, measured fresh, 7.90 in.; alar ext., 12.50 in.; tail, 4.10 in.; tarsus, 1 in.; 3d and 4th primary quills longest."

[1] Pronounced Hilgaro.

## MNIOTILTIDÆ.

**25. Granatellus francescæ** Baird. Rev. Am. Birds, p. 232. "Rose-breasted fantail; Rosillo."

"This handsome little bird is one of the new species discovered by me in the Marias. I always met with it among the low underbrush in the dark recesses of the forest, hopping about among the decayed logs and brush, near and sometimes on the ground, busily searching for insects; at every move it has a peculiar way of jerking up and spreading its pretty fan-shaped tail, at the same time the head motionless, and bent towards the ground, the wings recumbent, as if intensely looking for some little beetle or grub there concealed. Its notes are a feeble t'cit, t, cit. Its habits solitary."

**26. Parula insularis** Lawr. Am. Lyc., N. Y., Vol. x. p. 4. "Tres Marias yellow-throated Warbler; Silvestre."

"This lively little sylvia may be seen and heard in every tree, often repeating its delicate little song, at the same time busily searching among the foliage for apterous insects, and darting after passing flies."

## TROGLODYTIDÆ.

**27. Thryothorus felix** Scl. "Tres Marias Wren; Reyezuelo."

"Seems to be identical with the one found upon the main land, which closely resembles it. The Island species is a little larger, but the notes are similar. It is very common in the Marias, where it is a constant resident, and the only species of wren found there, where its lively song chimes in with the other songsters of the woods at all hours of the day. Total length, 6 inches."

## TYRANNIDÆ.

**28. Myiarchus mexicanus** (Kaup). (*Cooperi* Baird). "Cooper's fly catcher; Alguacil de moscas."

"A few birds of this species inhabit the Islands; I usually saw it among the low bushes, darting from its perch after flies and other winged insects. They are very silent, seldom uttering a note.

"Total length, 9 in.; tail, 4; tarsus, .95; bill, brownish black; under mandible paler at the base; feet, black; iris brown."

At the request of Mr. Sclater, the type of *M. mexicanus* was sent him by Dr. Kaup, and was found on examination to be the species

generally known as *M. cooperi* Baird, of which it has precedence, thus sustaining the specific value of my *M. cinerascens*, which has by many been referred to *M. mexicanus*.

29. **Myiarchus lawrencii** (Giraud). "Lawrence's fly catcher; Alguacil de moscas."

"This little fly catcher is very abundant in the Marias, where I met with them every day, in all parts of the woods. These Islands must be their most natural and favorite abode. I do not remember to have met with it on the main land. Length, 7 in.; alar ext. 9.75; bill and feet, black; iris, brown."

30. **Empidonax difficilis** Baird. "The lonely fly catcher; Tristecillo."

"Is common in the Marias, as well as on the main coast; and also in California. The accustomed places of resort of this solitary little bird are the most retired and secluded dells of the forest, where, beneath the canopy of the natural and shady grottos, formed by the overlapping branches intermingled with innumerable lianes, convolvulus and other creeping plants, it sits upon some low twig, watching for a passing fly; or it may be seen frequenting some secluded and shady little brook, near the surface of which it often darts upon the skimming water flies, ever and anon uttering its low and plaintive one syllabled note.

"General colors brown olivaceous above, with the entire under parts bright yellow, intense on the throat and chin; a conspicuous, pale yellow ring around the eye; also two bands across the wings of a light yellowish tinge. Bill dark brown above, yellow beneath, rather broad and depressed; feet dark brown. Total length, 5.20; tail, 2.25."

31. **Elainea placens** Scl. "Little golden crowned fly catcher; Coronillo."

"This species is rather rare on the Tres Marias."

## COTINGIDÆ.

32. **Hadrostomus aglaiæ** var. **affinis** (Elliot). "Rose-throated fly catcher; Rosieler."

"In the Tres Marias, this bird is only found in the thick woods, where it is seen searching for insects, sometimes darting after them when on the wing, at other times looking for them among the leaves and branches not unlike the warblers. Its notes are feeble and but seldom uttered, and its habits solitary.

"The colors of the upper parts are dark plumbeous, inclining to dark brownish or nearly black on the tail. The top of the head with a broad, rather flattened crest, is black, shading into brownish on the forehead. The lower part bluish gray, slightly tinged with brownish on the abdomen and crissum; chin ashy white; upon the throat and fore part of breast, is a broad patch of bright carmine or rose color, a distinguishing contrast to the otherwise rather dull plumage. The wings are dark brown, edged externally with plumbeous. The bill is nearly black above or very dark brown, the under mandible, bluish horn color; feet, bluish grey, nails, bluish grey; iris dark brown."

"♂ Total length, 6.60; alar ext., 11 in.; tail, 2.75; second, third and fourth quills longest. Body robust; head, large; bill, strong, slightly decurved, and rather compressed towards the tip.

"The colors of the female are different, the entire under parts are of a pale brown or rather buff color, an obscure band of the same passes entirely around the neck, posterior to the nape; the forehead is tinged with the same hue. The top of the head and back is a dull brown, with a plumbeous tinge; tail, brown; wings, reddish brown; the crest is as broad, but shorter than that of the male, and of a darker plumbeous brown than the back."

Specimens from the Tres Marias agree closely in color and dimensions with specimens from Jalapa, being somewhat smaller than examples from some other parts of Mexico.

## ICTERIDÆ.

33. **Icterus graysoni** Cassin. "The Tres Marias Oriole; Calandria."

"This superb oriole is one of the most beautiful of its kind, and is entirely confined to the Islands of the Tres Marias, where it is the only representative of its genus.

"There is a closely allied variety on the main coast (*Icterus pustulatus*) but in comparing the two, the difference in the markings is at once observable, as also the larger size of the Island bird. The Tres Marias oriole proves to be a new and interesting species to be added to the already long list of the *Icteridæ* at present known.

"The nest of this oriole, like all of its congeners, is pensile; generally suspended from the extreme end of a slender, decumbent branch or twig, in some shady spot, where it may swing to and fro by the breeze free from entanglement with other branches. The nest, which

is purse-shaped and about twelve or thirteen inches in length with the entrance near the top, is composed of a long, narrow grass or the fibres of maguey leaves, which are very strong and elastic, and lined with silk cotton; it is firmly and well woven together, and would be difficult to pull apart; it differs a little in form from those found in the vicinity of Mazatlan.

"Few birds surpass the oriole in discovering the hiding places of the various kinds of insects and their larvæ, upon which it feeds. With its exceedingly sharp bill it searches and probes every crevice in the bark and leaves of trees, and with unceasing industry; the number it destroys in one day alone must be very great. Thus we here see beauty and elegance combined with utility, in the place assigned to this species in the great economy of nature, in checking the accumulation of the insect kind. During my stay upon the Islands, I often saw them clinging about decaying logs or branches, sometimes with their heads downwards, busily engaged in piercing the rotten wood in search of wood worms or borers and white ants; it also feeds upon various kinds of fruit, Pitahaya (*Pitajaiœ cactus*) they are very partial to. In the Islands of the Tres Marias these birds become excessively fat, finding there an abundance of food, with nothing to molest them in their peaceful green island home."

## TANAGRIDÆ.

**34. Pyranga bidentata** Swain. "Tres Marias Tanager; Burion."

"I found this species abundant in the Islands, where it is a constant resident. I have nothing especial to note of its habits."

## VIREONIDÆ.

**35. Vireo hypochryseus** Scl. "Tres Marias Vireo."

"This species is quite common in the Marias, where I found it in all parts of the woods, from time to time uttering its cheerful little song."

## FRINGILLIDÆ.

**36. Cardinalis virginianus** (Linn.). "Cardinal Grosbeak; Cardinal."

"This bird is remarkably abundant upon the Marias, where it is a constant resident. It is not so numerous on the main and adjacent land.

"I was surprised to find this old and familiar acquaintance in this remote region, upon the very confines of its wide-spread geographical distribution, where its bright red plumage, its beautiful crest of crimson, its charming song, and above all its fondness for the habitation of man, — recalled the almost forgotten associations of my earliest boyhood days, in a far distant land."

37. **Chrysomitris mexicanus** Sw. "Mexican gold-finch; Canario."

"This is another species found in the Island which is also common to the main land."

## TROCHILIDÆ.

38. **Circe latirostris** (Sw.) "Shiny Green Humming Bird; Chopa-flores."

"I found but two species of humming birds in the Islands, and these were quite numerous. The present one is decked in a brilliant plumage of shiny green upon the upper and lower parts, with the exception of the front part of the head and chin, where the green shades into an invisible dark blue—these colors in some lights give forth bright metallic reflections, more beautiful than the purest emerald; the wings are a purplish brown and considerably recurved; the tail, which is moderately short, is forked, the feathers of which are broad and dark; shiny green above, with a slight obscure tip of lighter color; the crissum white, with dark invisible green marks upon the under tail coverts. Bill, compressed at base; where it is orange red, both above and below, the rest black; it is slightly curved or arched, and .75 in. in length. Total length of bird 3.5 inches.

"The nest of this lovely species, which I had the good fortune to discover, is equal in interest, and as beautiful in form, as the bird itself. The elegant little structure I found attached to a slender twig, and shaded with its leaves, about five feet from the ground. The situation was fronting the sea, but a few paces from the water's edge, where the first beams of the morning sun dissolved the dews. Its form is cup-shaped, and composed of the down of the silk cotton tree (Eriodendron), intermingled with the down of other plants and spider webs, the whole exterior neatly studded with diminutive whit-

ish lichens; it contained two newly hatched young, but little larger than flies."

Col. Grayson's description, as given above, differs from *C. latirostris* in making the front blue and the tail green, whereas in that species there is no blue on the front, and the tail is steel blue; in all other respects it agrees with *latirostris*; as Col. Grayson says he obtained but two species of humming birds at the Marias, and I find in his collection from there only *P. Graysoni* and *C. latirostris*, I can only conclude that his description is intended for the latter species, and the errors were made by some inadvertence. Col. Grayson states that neither of these species inhabits the main land, but in his collection from Mazatlan, no doubt made subsequemtly, I find a specimen of *C. latirostris*; *P. Graysoni*, however, has not been found elsewhere than at the Tres Marias.

**39. Pyrrhophæna graysoni** Lawr. "Cinnamon-breasted Humming Bird; Chopa-flores."

"In my visit to the Tres Marias it has been my good fortune to discover this new addition to the large group to which it belongs.

"This rather large humming bird is very abundant on the Islands, where they seem to be continually at war with each other; in fact they attack every bird, and even the butterflies, should they approach some chosen flowering plant which they guard unremittingly as their own treasure. As they dart like a golden sunbeam through the woods, they often utter their shrill note of t'weet, t'weet, t'weet.

"Sometimes combats between them become of a desperate nature. One day while watching a number of them in active motion around some tobacco flowers (of which they seem to be very fond) two fine males after darting at each other for some time, at length came to a deathly struggle, high above my head; they finally clinched each other, each having one of the mandibles of the other in his mouth, at the same time scratching with their little claws, and using their wings with the greatest force, and in this situation, whirling round and round they fell to the ground near my feet. During this terrible conflict, in which passion and desperation were exhibited, I observed them for a few seconds and then gently placed my hat over both; even after they were thus captured, and I held one in each hand, they evinced a desire to continue the war.

"I have seen this species frequently darting from its perch upon passing diminutive flies like a real fly-catcher. I found the gizzard,

when examined, always well filled with them and other minute insects.

"Neither of these species have I seen on the main land; it would seem, therefore, that they belong entirely to this locality, where perhaps other species may yet be found.

"Here amid such luxuriance of flowers and leaves, and wild entanglement of climbing plants and vegetable glory, it would be surprising if no others should be discovered in this favored spot, where the flowers seem to vie with the brilliant tints of the 'brave little humming bird.'

"The bill of this species is long, but slightly arched, depressed at base, where it is orange-yellow above and below, the rest black; the wings a little recurved, and of a purplish brown, tail with broad feathers and slightly forked, is of a deep cinnamon red, tipped with black and green reflections; the balance of the upper parts golden green with metallic reflections, slightly tinged with rufous on the forehead. Entire under parts light cinnamon red, or rufous. Iris, brown; feet dark brown. Total length, 4.75; alar ext. 6.5; bill, 1.02; tail, 1.75."

40. **Thalurania luciæ** Lawr.

41. **Florisuga mellivora** (Linn).

42. **Cyanomya guatemalensis** Gould.

43. **Petasophora thalassina** (Sw.)

44. **Chlorostilbon insularis** Lawr.

The last five species were obtained at the Tres Marias by Capt. J. Xantus, and none of them were observed by Col. Grayson, nor did Mr. Xantus obtain either of the two found by Col. Grayson.

## ALCEDINIDÆ.

45. **Ceryle alcyon** (Linn). "Belted Kingfisher; Pescadoro."

"I met with this species along the sea shore, sitting upon the rocks, solitary and rare. It appeared to be accidental in the Tres Marias, although I observed one or two individuals upon every visit I made to the Islands. It is common upon the main land in this locality."

## HÆMATOPODIDÆ.

46. **Hæmatopus palliatus** Temm. "Red billed Oyster catcher; Agarrador."

"Common on the sea shore of the Marias, as also on the main coast, from whence perhaps it visits this locality."

## CHARADRIIDÆ.

47. **Ægialitis semipalmatus** (Bp.). "Little Plover; Frailecillo."

"I procured one specimen of this bird on the shores of the island."

## ARDEIDÆ.

48. **Ardea herodias** Linn.

49. **Herodias egretta** (Gm.). "Garza."

50. **Garzetta candidissima** (Gm.). "Garza."

"The above three species appear to be only accidental or straggling visitors to the shores of the Marias. Common on the main land.

51. **Nyctherodius violaceus** (Linn.). "Yellow-crowned Night Heron; Garza."

"I procured a few specimens of this heron in the Marias, some of which were in adolescent plumage; this led me to suppose that a few individuals may breed there. I found it in about equal numbers in the Socorro Island. It is a common species upon the main land."

## LARIDÆ.

52. **Haliplana fuliginosa** var. **crissalis** Baird, M. S. "Black-back Tern; Sooty Tern."

"Numerous in the vicinity of the Islands of the Tres Marias; it breeds upon the small island of Isabele, near San Blas. This species is never seen near the main shore, usually keeping far out to sea. I have never met with it in any other locality, but the southern part of the Gulf of California in the neighborhood of the Marias. It appears to be semi-nocturnal. It is a constant resident in the localities above cited."

This differs from *H. fuliginosa* in having the under tail coverts tinged with ashy, instead of being pure white.

"This comprises the list of land birds discovered by me during my comparatively short stay upon the Marias; doubtless a farther investigation may bring to light other species from this interesting locality.

"Various species of sea birds common to these latitudes are seen

along the shores and rocks, which I have excluded from this catalogue as not being strictly inhabitants of these islands, but noted wanderers of the sea."

"Of mammals, I discovered but two species of any importance; one a rabbit, apparently a new species and very abundant, and the common raccoon.

"A small species of bat is found, and I also saw indications of wood mice, and was informed that a small species of opossum inhabits the woods, being but little larger than a common mouse (perhaps related to *Didelphys tristriata*),— a species allied to which I found in Tehuantepec."

"Among reptiles, there are two or three species of *tree* snakes, and the Mexican anaconda is sometimes met with. Various species of lizards are abundant, among which a very long one, two feet in length, known as the iguana, is very common; scarcely a hollow tree in the woods but is occupied by some venerable hermit of this species, who may be seen basking in the balmy air just in front of his door, into which he darts when you approach too near. They are all harmless. This species appears to be different from those found upon the main land."

" Of shells, there is but one variety of land shells, which, however, exists in great abundance. It has six whorls,—increasing regularly, streaked longitudinally and irregularly with white and bluish-horn colored stripes,—average length, two inches. I found many of these shells during the dry season, in hollow trees and knot holes; in this situation I always observed that the shell itself had closed its door with a gummy substance, evidently intended to exclude the dry atmosphere, thus hibernating until the rains awakened them again from their winter sleep."

" NOTE. About half past ten o'clock P. M., Jan. 25, 1865, an unusual large and magnificent meteor passed over the Island, in a northeast direction, exploding near the surface of the water, about twenty miles distant. There were two or three very loud reports, not unlike the bursting of bomb shells, accompanied with a rushing sound, caused perhaps by its passage through the air. The Island was brilliantly illuminated for a few seconds during its passage over, the altitude of which did not seem to be very great."

# Exploring Expedition to the Island of Socorro, from Mazatlan, Mexico. By A. J. Grayson.

"Socorro is the largest of the group known as the 'Revillagigedo Isles,' and is situated in Lat. 18° 35' and Long. 111°. It is about twenty-eight or thirty miles in length and twelve in width; its greatest altitude 2,000 feet; the shores are bold and rocky, and as there are no sand beaches, to make a landing in any of its coves, even in calm weather, is attended with great difficulty if not danger.

"The entire island is rent and torn by volcanic action, to such a degree as to render travelling in the interior very laborious.

"The 'Revillagigedo Islands' were so named by Capt. Collnett, in 1793, in honor of the Mexican Viceroy. Capt. Collnett was commander of the British vessel captured by the Spaniards at Nootka Sound in 1788 or 1789, and carried to San Blas as a prisoner, where he was confined some time, but was released by order of the Viceroy, then in the City of Mexico.

"The Island now called Socorro (Succor) was discovered by Hernando de Guxalvo in 1533, and was by him named 'Santo Tomas,' which name it bears on all the ancient maps and charts. It derived its present name from the timely relief which it afforded to a ship's crew suffering severely with the scurvy, who were completely restored to health by the use of that valuable antiscorbutic, the prickly pear, which was found in abundance on the Island. This was in the latter part of the last century.

"On the second day of May, 1867, about 5, P. M., we sailed from the port of Mazatlan on board the sloop 'Republicana,' of twenty-five tons, commanded by Capt. Garcia, a Mexican.

"My companions were my son, Edward Grayson, and my Mexican servant, Christobal, a boy of fourteen years, to assist me in making my collections of Natural History, etc. A Mr. Anderson accompanied the expedition, representing other parties, for the purpose of examining the Islands as to their utility for farming and other purposes; my object being to make a more thorough research of its natural history, than I had done on a previous visit. The wind being fair but light, we made a good offing by dark, and headed for Socorro Island. At 12 M. of the 3d, Lat. 22° 50', Long. 117°, the mercury was 85° Fh. in the cabin, and it was very warm on deck, there being no shade. On the 4th we sighted the 'Tres Marias' Islands, bear-

ing south of us. We continued four days in sight of these Islands at a distance of thirty miles from them, with calms and light winds. We amused ourselves fishing, in which we had considerable success, —there being soundings for some distance northwest from these Islands. A small green humming bird paid us a visit, of the species I found abundant on the Islands when I was there three years ago, and excited our astonishment that it should venture so far from its green retreats; it remained but a few moments, apparently examining our vessel, when it suddenly departed for its island home.

"The black-billed terns were numerous on these soundings, as well as guillemots, petrels and gannets. Occasionally a tropic bird (Phaëton) came around with its long tail feathers glistening against the sky. But none of these birds came near enough to be shot. With our scoop net we procured a number of floating sea snail shells, buoyed upon the surface of the water by means of a thin substance full of little air cells, which resembles sea foam. The shell is very fragile, has three whorls, and when disturbed ejects a purple fluid; we saw many of these shells floating on the sea in calm weather, between the Marias and Socorro Island. On the 9th the Tres Marias Islands had disappeared below the horizon. Numbers of black-billed terns fly around to-day of which we shot and prepared two specimens; at 12 o'clock M., Lat. 20° 38′, Long. 108°, the mercury stood at 86 Fh. in the cabin. From this time forth the voyage was very monotonous, until the 14th, when we at last sighted the Island of Socorro, at half past 6 P.M., bearing west, my son being the first to see it.

"By this time the wood for cooking purposes had entirely given out and our provisions were also getting low,—we had neither pickles nor vinegar, nor dried fruit nor vegetables of any kind; nothing but dried beef and hard bread, with a little coffee and tea, and all on hand would not last more than twenty days even with strictest economy at that, notwithstanding according to the charter contract, there was to be provisions for two months. But I came to the determination, that if we reached the Island, I would live upon fish before leaving it until the object which brought me there had been accomplished.

"For four days, the wind headed us off from the Island most provokingly, or rather from a landing place. We first endeavored to go around the north side, but found it too difficult on account of head winds; we then tried the south and after beating against the wind and a strong current, finally reached the cove marked on the

chart as Cornwallis Bay. In this cove, I had been two years previously.

"Although it is a very unsafe anchorage, yet it is the only place we could find fit to come to anchor, in which we might lay with any show of safety. The shores of this cove are rough and rocky, upon which the sea breaks in the calmest weather. There is no beach to land upon, instead of which, at its head, are heaped up round water-worn stones, and its sides are bold and precipitous. We did not see when sailing nearly all around this Island, any beaches or a better place to land than this little cove, which opens broadly to the southwest.

"On the 19th of May, seventeen days from Mazatlan, we ran into this little bay with a fair breeze, and delighted with the green trees at the head of the cove and the song of birds among them. But the captain appeared to feel a great deal of uneasiness at the general appearance of things. He let go the anchors as he thought a little too near the shore, and the breakers so near and all around, filled him with fear; and just when we felt that all was safe and our voyage at an end for the present, he ordered the anchor to be hauled up and at the same time the main sail hoisted, with the intention of beating out against a head wind; his excuse was that the anchor would not hold. But this movement proved fatal to our craft. Before headway could be made, she was driven in by the wind and swells among the breakers near the shore; both anchors were again 'let go,' but it was too late, her doom was sealed. We made every effort to haul her out by kedging with the small anchor, this being taken ahead with great difficulty in the little skiff and dropped—we would then pull upon the chain; but futile was the effort. Her centre-board had already struck and broken off and her keel was thumping on the rocks as she surged heavily at her chains, which threatened every moment to part.

"We now turned our attention to saving the water and provisions; the former giving me the most anxiety. As for the latter I had no fears, as fish of excellent quality swarm around the shores and are easily taken with hook and line. We still had hopes of saving the sloop when the sea became a little smoother, as she was not yet much damaged. We however, made preparations for landing everything we could. A rope was fastened to a point of rocks about twenty-five yards distant, to facilitate our landing, and the skiff was pulled back and forth just when the sea would give us an opportu-

nity of jumping ashore; much caution had to be used in this exploit, the sea breaking furiously at times upon this rock.

"Mr. Anderson being sea sick, from which malady he suffered the entire voyage, was first put on shore, afterwards my son and the boy Cristobal were landed, in order to receive the different articles as they were thrown to them from the skiff. The water casks were all hoisted on deck in order that should the sloop break up, they would float ashore; the provisions, guns, ammunition, and other articles most needed for the expedition were all soon safely landed.

"I remained on board till all these things were on shore. Cristobal, who had gone a few steps up the cove, suddenly cried out to me with demonstrations of the most lively joy, "*agua, agua-dulce*," pointing at the same time to an ugly pile of rocks upon which he was standing.

"There indeed we found a small spring of warm water gushing out of a seam in the solid rock that forms a precipice on the western side of the cove; it was partly concealed by a pile of rocks and boulders, which is often covered by the tide, and the spring so low down would naturally be taken for tide water running back into the sea.

"The uncertainty of the length of time we would have to remain before being rescued from our exile, for it is well known that vessels seldom pass near this island, rendered this discovery of the highest importance. The contemplation of the hardships, toil and intense suffering in searching for water in a locality where it seemed extremely doubtful of success, filled my mind with the greatest anxiety, but it was now dispelled by this unexpected discovery, and I felt pretty certain that the preservation of our lives depended upon it. This I became more and more convinced of, as we made frequent and laborious excursions without being able to find it elsewhere.

"During the day the sea became rougher, and the small anchor chain parted and nearly all of the sloop's keel broke off. She still held by the larger anchor.

"All the articles landed were taken up to the place selected for our camp, beneath the shade of the trees, which at the head of the cove are of profuse growth. As soon as it was dark, being much fatigued by our day's work, we retired to sleep. About two o'clock, A.M., we we were aroused by the loud shouting of one of the sailors left on board the sloop. We hurried to the spot and found she had broken the chain and was already hard and fast upon the rocks close to

shore, rolling and thumping, and the water casks which had broken loose were dashing about over the deck most frightfully, endangering the legs of the poor sailor. On the 20th, every movable article that remained on board was taken off; this was safely done, because at low tide one side of the vessel could be reached without the aid of the little skiff, which was now hauled up on shore for safety. Nearly everything was saved, even the clock, cooking stove, culinary utensils, implements, sails, etc., all of which, the smallest articles, we prized and treasured up for some future necessity, in anticipation of a long abode amid the wild solitude that surrounded us. We arranged our camp in order, beneath the strange trees, the trunks and branches of which are bent and crooked into every conceivable shape. The wide spreading branches, thickly clothed with leaves, were ample protection against the intense rays of the sun.

"This tree seems to belong to the *Euphorbiaceæ*. When the bark is cut a thick milky sap flows freely, which very soon becomes congealed, and would doubtless form caoutchouc; it bears a fruit resembling small green apples, also containing a profusion of milky fluid. This fluid is poisonous to the skin; some of the party were poisoned by it. These are the largest trees upon the Island, and the largest of them would not measure quite three feet in diameter at the root; but the branches which commence near the root are long, and horizontally inclined toward the ground, the leaves are ovate and smooth, of a delicate green color; the fruit, also smooth, contains clusters of hard seed inside the pulp; the flowers are without petals or fragrance. Specimens of this tree, together with all the plants collected and packed up, were unfortunately left behind. Other shrubs and plants found upon the Island are of a scrubby nature. Among the branches of the trees around our camp, the little warbler (*Parula*) and a busy, happy little wren, sing from morning till night. The new mocking bird, too, occasionally gives us a touch of his melodious song, sometimes imitating the scream of the *Buteo montanus*, and the pretty parakeets with their grass green plumage are chattering and whistling all through the grove. Numbers of the little towhee finch (*Pipilo*) that pointed out the water to Cristobal, came around us picking up the crumbs of hard bread thrown to them, and drinking and bathing in a basin of water placed on the ground for their special use. All these birds were remarkably tame; they confidingly came around us, and seemed to be as much pleased with our society as we were with theirs.

"Our camp was now put into systematic order. We constructed seats of boxes, and out of the hatch covering of the sloop we made convenient tables, also swinging shelves for drying specimens upon. The stove was put up for cooking, and an excellent fish (called by the Mexicans *cabreca*), was caught with hook and line, just as needed for the table. This species is very abundant and fat, some of the largest would weigh from ten to twenty pounds; they are oblong in shape, with large mouth, and of mottled brown and grey color, swim near the bottom and are very voracious. There are several other species in great abundance, some of which are very pretty. One kind is of a brilliant bluish green color; another species resembles the gold fish. Many of these fish are new to me, and may be to science, but I was unprepared for preserving specimens of this nature for the want of alcohol.

"As our small stock of provisions would soon be exhausted, we came to the conclusion that fish would be our principal means of subsistence; under these circumstances, however, we were in good spirits, and went to work as though nothing had happened, in making collections and exploring the Island.

"The climate is very uniform and balmy, in the shade the thermometer varying only from 70° to 75° Fh., and almost a constant breeze from the west or northwest. On the 21st we went some distance exploring and hunting. My son discovered the signs of the hogs, a pair of which I left here two years ago; from the number of tracks large and small seen, they have increased. This was a happy discovery, as we could now have lard to fry our fish. He captured a very small owl and a new dove, both new species I think. I found the country exceedingly rough and barren of trees, with the exception of a few scattering ones in the gorges, though otherwise clothed with low brush, of a species of *wormwood*, also coarse grass and weeds; these, combined with the sharp volcanic stones, made my progress tedious and irksome. I found no indications of mammals of any kind, and no new species of birds other than those found in our little green cove. Shot two hawks (*Buteo montanus*) and returned late in the evening very much fatigued.

"May 22. Preparing specimens all day. We captured all the birds, with a few exceptions, by means of a running noose fixed to the end of a slender pole, which is cautiously slipped over the victim's head, and with a sudden jerk the bird is secured alive; this extraordinary mode of catching birds I learned from the Mexicans

on the Tres Marias Islands. About one o'clock in the night I was awakened by my dog growling and showing signs of uneasiness, when I heard some large animal walking around among the leaves and brush. I remained quiet, endeavoring to make out what it could be; it made a circle around our camp as if to get the wind of us. I at length heard it blow, which I recognized at once to be that peculiar snuff generally made by the hog family on certain occasions of alarm. I was soon satisfied of, as well as gratified by, this fact, for on calling to her familiarly, she came fearlessly into camp, and to my joy proved to be the same black sow that I had left here only a pig two years ago, and equally as tame now as then. She seemed to be glad to see us, welcoming, as it were, the return once more of human beings to her lonely home. She had grown to be a large hog, very fat, and far advanced in pregnancy. She remained with us constantly during our stay and gave a domestic appearance to our camp. We left her there when we came off, where she may continue to increase the breed, for the benefit of some future castaways. We never could find the others, though we saw their numerous tracks. Day after day some of us were occupied in exploring the interior of the Island in various directions, which we always found to be very laborious and tedious, particularly as we could find no other water or new specimens of birds or mammals. The sailors and the captain were engaged in making a wall around the little spring for the purpose of keeping the tide from running over it, which it often does. The water of this spring when first coming out of the rock is warm; it is good soft water, however, and when cooled is good for drinking.

"We kept the casks saved from the wreck, filled for fear of accident. Over the spring we marked with white paint, on the steep rock out of which it flows — ☞ water — in Spanish *agua*, thus any one visiting this place would be sure to find it. This is the only water we found upon the Island, but it is very likely that it exists in some places higher up the mountain, in the deep impenetrable gorges, which we saw but did not enter.

"We travelled over a large portion of this Island, and found its general aspect excessively rough, lonely and forbidding. There are but few varieties of plants, as of birds; but these are nearly all new to me. A stiff, unyielding brush, with occasional bunches of prickly pear, augments the difficulty of walking over the rough, stony surface. Large tracts of lava run to the sea on the south side, from the extinct volcanoes, leaving unmistakable evidence of their fury.

These lava paths and craters can be distinctly seen from the ocean a few miles from shore. Our shoes were soon worn out by these sharp rocks, and some of our party were compelled to make shoes, or rather a nondescript between a shoe and a moccasin, of seal skin, which happened to be on board the sloop.

"On the morning of the 28th I started out early and alone, prepared to ascend the mountain and penetrate as far as possible the interior; hoping to find something new and worthy of a place among my collection, as well as to learn more of the topography of the country. After travelling for a few miles over volcanic ridges, intercepted with brushy gulches and vast piles of crumbling sharp stones, I at length reached the head of a small, deep valley, which is overgrown with scrubby brush and an occasional small or stunted green tree; this dry valley or gulch runs toward the southern shore of the Island; two deep gorges are here confluent, coming from towards the mountain peak that stands near the centre of the Island; these gulches are very rocky and enclosed with precipices on both sides. I descended with some difficulty into this valley, for the purpose of going up one of the gorges mentioned; they had a fresh green appearance in their narrow windings, in which water might be found; and where there is water, there would be found most likely the objects of my research; I observed the small ground dove (*Chæmepelia?*) passing up these gulches, may be to some watering place.

"On attempting to explore these wild and mysterious regions, I found the difficulty too great, on account of the tangled brush and the rank coarse grass that grew among it; there were also many strange looking holes, which had the appearance of having once been the vents of an interior fire, now extinct. The ground sounded hollow, as I stumbled over these places, and a horrible sensation came over me as I thought of the danger of falling through into some dark cavern, from the gloomy depths of which there could be no return to light. With these obstacles surrounding me, the idea of penetrating this gorge was abandoned for the present. Before again ascending the ridge I set fire to the grass, for the purpose of clearing away these impediments, and would at another time make the attempt with a better chance of success. The fire soon spread with great rapidity, making clean work of brush and grass. Immense columns of black smoke ascended to the clouds and might be seen fifty miles at sea, were a vessel within that distance. On again

reaching the summit of the ridge I proceeded on my course up the mountain, making my way the best I could over the rough ground. I had become very much heated and out of breath, there was no shade to invite repose, the scenery around looked dry, hot and wild in the extreme. I met with but few solitary birds, such as the little ground dove, mocking bird and little wren, and these had a gloomy, listless look, conformable to the sombre solitudes, which could call forth no song from these silent creatures; indeed, scarcely any animal life could be seen; sometimes a small blue lizard basking on the rocks, or a solitary grasshopper started from the grass, was all the living things to be encountered in my rambles of that day. In my route up the mountain, and upon an adjacent ridge, I beheld a large and isolated rock, which had so strange an appearance that I was led to examine it more closely. At a distance it looked like a part of a broken wall of some vast ruin. A mile or so of tedious walking brought me to it, when I found it to be about sixty feet high, forty or fifty feet in length, and only about ten feet thick at base, standing perpendicular upon its edge and perhaps welded to a solid mass of the same formation below the surface of the earth where it stood. On examining its rough exterior I found it to be glazed over the entire surface, as if but recently taken seething from some huge melting furnace; the whole mass had the appearance of a large block of dull, yellowish porcelain, equally as hard and flinty; in places a slight tinge of pink was perceptible.

"From this point an extended view of the wild scenery lay before me with its broken and rent forms of gulches, fissures, ridges and rude heaps of black rocky scoria. The lava paths could be distinctly traced, running to the sea. Some very curious forms are produced in the jagged rocks that stand like sentinels along the rock-bound shore. One of these is the "Old man of the rocks," at the extreme southeast point of our little bay. These rocks are exceedingly sharp and rough, extending some distance into the sea, and making a very dangerous reef. Upon one of these isolated rocks is the colossal figure of a robust man in a sitting position, with arms folded and head thrown back, gazing forever upon the eternal sea, whilst the breakers are dashing furiously against its pedestal.

"While resting near these rocks, my eyes suddenly rested upon a dark speck to the northwest. I was soon satisfied after a second look, that it was a sail, and apparently heading towards the Island with a good breeze. The smoke which I had raised and now spread

far and wide had doubtless been seen. I started to camp as fast as the nature of the ground would permit, in order to signalize her should she come near enough to our cove. I felt, however, indifferent as to her coming in, as I had not satisfied myself of the full and complete exploration of the Island, and I was not quite ready yet to go.

"By the time I reached the camp none of my companions had seen her, although she had arrived abreast of our cove, five or six miles off, and under full headway was sailing past. Signals of smoke was made as soon as possible, by firing the dry grass on the surrounding hills, while my son Edward, with a white flag, ran out on the extreme point of rocks. The sight of this flag brought her to. She came within about three miles and sent a boat to see what we wanted. The sea was very rough and was breaking furiously in the cove. As the little boat neared the shore, I felt the chances of getting off in her very doubtful; the only place that we could embark was a bluff point of rocks, upon which we had made the first landing, but the waves were now breaking against this with great force. The boat, however, came near this point, and when an opportunity offered, her stern was backed up to the rocks. Eddie, supposing the mate, who was in the stern, wished to come ashore to make some arrangements about taking us off, reached him his hand to assist him in jumping ashore, but instead of doing so he pulled my son into the boat, and one of our sailors jumped in after him. She pulled off immediately to keep clear of the breakers.

"The mate then informed me that the bark was the A. A. Eldridge from San Francisco, bound for Valparaiso, and that he would return for the rest of us. I went to camp and packed up such things as could be taken off. But after the boat returned the mate told me he would not take the smallest package in the boat, and if our lives were saved we ought to be thankful. Upon these conditions I hesitated about going, but as my son was already on board there was no alternative; especially as he, the mate, said he would not return again, fearing to lose the little boat. The idea of going to Valparaiso was out of the question, but I would not be separated from my son, and so determined to go, the mate crying out that he would only give us five minutes to decide. There was no time to be lost, and unavoidably leaving everything behind, we jumped into the frail boat; the sea was growing more stormy, and amid the roar of breakers, heightened by the thundering of the waves into a cavern,

we pulled out of the cove to the bark. Captain Abbott (her captain) treated us with genuine hospitality, and I shall always remember him with grateful feelings. He agreed to land us on the Tres Marias Islands. I prevailed upon him to send the boat for some of my things left behind which I prized the most, particularly the Natural History collections. But when the boat returned nothing could be brought off but the two boxes of specimens; the little boat came near being stove against the rocks in this last attempt.

"Thus the expedition was suddenly and unexpectedly brought to an end. It was my intention, had we not been wrecked, to have spent a much longer time in examining this as well as the adjacent Island—but "*diis aliter visum.*" Darkness had now begun to shut out from view the lessening shores, as we sped on our course to the Marias. The mountain and clouds were brightly illumined by the flames of the burning grass and brush, which had spread in every direction, recalling to the imagination the long ago, when the volcanoes were in action, and the lurid lava blazed in all its desolation over this solitary Island, where it still remains as these convulsions have left it, in all its primitive grandeur and its wild solitude. Year after year the grass springs up on its hills uncropped by the herd; the songs of the birds are only heard by their mates; the fishes gambol and sport in the little bays undisturbed, and old ocean, as in countless centuries past, still roars and foams upon its lonely shore.

"In three days we reached the Marias, where we remained four days. I made daily excursions in the woods for birds, but found nothing new, but what I had collected on a former visit to this locality.

"We sailed in a small schooner for San Blas, in order to get a vessel for Mazatlan, where we arrived in twenty-four hours from the Marias, ragged, dirty and without money. This place is noted for the unhealthiness of its climate and the tormenting insects that infest it. The natives, too, have a bad reputation, and it was much against my will to go there, but it could not be avoided, and I cannot help but feel, from the strange coincidents which had transpired, that a mysterious agency had directed us to this fatal spot, where my beloved son should meet with an untimely and most cruel death, by the rude hand of some unknown assassin. For what cause this shocking deed was committed, and by whom, in this land where the murderer goes free, will in all probability forever remain a profound mystery."

## LIST OF SOCORRO ISLAND BIRDS COLLECTED BY A. J. GRAYSON, MAY, 1867.

### PSITTACIDÆ.

1. **Conurus holochlorus** var. **brevipes** Baird. Ann. Lyc. N. Y., Vol. x, p. 14. "Socorro Parrot."

"This parakeet is quite abundant and evidently belongs to this locality, which it never leaves; they are to be met with in flocks or in pairs. In the mornings they left the cove in which we were encamped, for the higher regions of the interior to feed, returning again in the evening to roost. This cove, in which the trees are larger and the shade more dense than in other parts of the Island, seems to be their favorite resort. I saw them at times walking about on the ground beneath these trees, apparently picking up clay or gravel; they are remarkable tame, exhibiting no fear in our presence. Three cages were soon filled with them, which were caught by hand, and their constant whistling for their mates brought many of them into camp, perching upon the cages and elsewhere; they feed upon a hard nut which they find in the mountain gorges, and on account of the inaccessible localities where this fruit grew, I was unable to find it. The powerful jaws of this parakeet would indicate the fruit to be very hard."

### TURDIDÆ.

2. **Harporhynchus graysoni** Baird. Ann. Lyc. N. Y., Vol. x, p. 1. "Socorro Thrush; Mocking bird."

"Not very abundant, but seems to be well distributed over the Island. It has all the characteristics of the true mocking bird in its habits (*Mimus polyglottus*). Of solitary disposition, it attacks every bird of its own species that approaches its usual haunts.

"One took up its quarters in our camp, and was certainly the tamest bird of this genus I ever saw; he appeared to take pleasure in our society, and attacked furiously every bird that came near us. He doubtless regarded us as his own property, often perching upon the table when we were taking our meals and eating from our hands, as though he had been brought up to this kind of treatment; at times ascending to the branches over our head, he would break forth into loud and mellow song, very thrush like. In the still hours of the night while roosting in the branches near us

he would sometimes utter a few dreamy notes, recalling to mind the well known habits of the true mocking bird."

## FRINGILLIDÆ.

3. **Pipilo carmani** Lawr. Ann. Lyc. N. Y., Vol. x, p. 7. "Socorro Towhee finch."

"This is an abundant species, found in all the thickets of the Island. Many of them took up their abode in our camp, picking up crumbs about our feet, as tame as domestic fowls. They delighted in bathing in the water we had placed in a basin on the ground for their use, and frequent combats took place between them for this privilege.

"It was through the agency of this species that water was discovered in a locality where we had not the remotest idea of finding it, and for this providential service, he was a welcome visitor and a privileged character.

"I found them at times feeding upon small seeds of plants; but more frequently on the ground scratching up the dry leaves in search of insects. Their notes are rather feeble, resembling slightly, in this as well as habits and general appearance, their congener of the Eastern States (*P. erythrophthalmus*).

"From those examined, I found that the breeding season was near at hand."

## TROGLODYTIDÆ.

4. **Troglodytes insularis** Baird. Ann. Lyc. N. Y., Vol. x, p. 3. "Socorro wren."

"This busy little wren is the most common bird I met with upon the Island, and everywhere its cheerful song may be heard in the trees or among the brambles and rocks. Like all the birds peculiar to this Island it is very tame. I often saw it feeding upon dead land crabs, and I may here remark that all the birds inhabiting the Island, with the exception of doves and parrots, subsist more or less upon crustacea."

## COLUMBIDÆ.

5. **Zenaidura graysoni** Baird, Ann. Lyc. N. Y., Vol. x, p. 17. "Solitary dove."

"Of all the birds I met with on the Island, these seemed to be the most lonely; not a flock or even a pair were ever seen together.

They are remarkably tame, perhaps more so than any bird of this order. One was captured by hand as it came into our camp and perched upon the rude table on which I was at work; its melancholy look appeared to be in keeping with the solitude of, and its sombre plumage corresponding with the grey brush and brown volcanic rock composing its wild home. In form and appearance, when alive, it resembles the common turtle dove.

"The first specimen seen and captured was by my son, Edward Grayson, whose name this evidently new species should bear, not for this discovery alone, but for the assistance often rendered in making my collections, and more particularly on this expedition, in which he was indefatigable, even to enthusiasm, in aiding its progress as well as the advancement of science, in the course of which he came to an untimely death."

6. **Chamæpelia pallescens** Baird. "Little Ground dove."

"This is a very common species on Socorro Island, as well as Tres Marias and main land, from whence they may have wandered to this spot, where they continue to breed and remain permanently."

## STRIGIDÆ.

7. **Micrathene whitneyi** (Cooper). "Socorro Owl."

"REMARKS. Iris bright yellow. Tarsus and toes dull yellow and covered thinly to the end of toes with hair like feathers. Bill dark bluish, the tip and inner edge of upper mandible white. Tarsus short and claws very sharp and delicate.

"Three specimens of this handsome little owl (perhaps the least of the entire genus) were captured. The first was caught by my son among the thick growth of trees that surrounds our camp, who came running into camp, saying 'here is the prettiest little owl we have ever seen.' It was caught with a running noose attached to the end of a long rod and slipped over the head of the unsuspecting day dreamer. Nearly all the birds were captured in this way. Contents of stomach, bits of small land crabs."

## MNIOTILTIDÆ.

8. **Parula insularis** Lawr. "Warbler."

"REMARKS. This bird seems to be identical with the Tres Marias species, and is quite common on the Socorro. Is a little larger than the Marias bird."

## FALCONIDÆ.

9. **Buteo borealis** var. **montanus** Nutt. "Western Red Tailed Hawk."

"This is the only hawk found upon the island, and here it is quite common, being a constant resident, rearing its young, and subsisting exclusively upon land crabs, which they find in great abundance, and an easy prey. Their claws are much blunted, doubtless caused by the frequent contact with the hard shell of these crustacea. This, and the night heron, are the only large landbirds found upon the Socorro Island."

## ARDEIDÆ.

10. **Nyctherodius violaceus** (Linn.). "Yellow-crowned Night Heron."

"Upon this remote island, where there is a scarcity of fresh water, I was surprised to find this well-known species. Here its natural haunts are entirely wanting. Here there are no lagoons or mangrove swamps to skulk in during the day; and the croaking of frogs, its favorite prey, is not heard. All is dry, and destitute of such localities suited to the nature of fresh water birds. I saw solitary ones in the day time perched upon the rocks in the interior of the island, and on one or two occasions, were started from the dry grass, where they were concealed. Hardly a night passed that I did not hear the well-known quak of this heron, as they came to our spring to drink.

"From the appearance of the male bird on examination, and the presence of the young one shot, they doubtless breed here to some extent. Feed entirely upon crabs."

## LARIDÆ.

11. **Haliplana fuliginosa** var. **crissalis** Baird. "Black Billed Tern."

"REMARKS. This tern is very numerous in the vicinity of the Tres Marias, and the little Island of Isabella, near San Blas, upon which they breed. About the Revillagigedo group they are only scattering, and replaced by another species—*a black tern with a hoary forehead*, which are quite numerous in this locality. Although I shot some of these from the deck of our vessel, yet I was unable to procure a single specimen; because the sea was too rough to launch our frail little skiff. I shot many other sea birds which I was unable to

get on this account. Had we not been so unfortunate in losing our vessel, it was my intention to have visited the rocks and islands adjacent to Socorro, for the purpose of collecting the various species of sea birds and eggs. But this misfortune put an end to further researches in this channel—much, very much indeed, to my regret."

## SULIDÆ.

12. **Sula cyanops** Sundevall. "Revillagigedo Gannett."

"Remarks. Bill pale violet; iris brown; bare space at forehead and base of the under mandible, purple red; feet do.; bare space around the eye, violet blue ; bare space of chin and throat, jet black ; toe nails white; nostrils indistinct. Contents of stomach, flying fish. The ovarium contained nearly developed eggs; the sternum I send with the specimen. The plumage of the sexes are about the same, immature birds grey on the upper parts, the color of bill and feet, paler."

"Inhabits the region about the Revillagigedo Isles, have not met with it elsewhere. Another species, nearly answering to the description of *Sula bassana*, is found in large numbers about the Tres Marias and upon the Island of Isabella; they breed upon the rocks and on the sand of this little Island, they lay but one egg—white, and nearly the size of a goose egg; both arents assist in incubation."

13. **Sula piscator** (Linn.). "Booby, or Bobo."

"Shot near Socorro. A common species in the tropical Pacific. Breeds on the rocks."

Some species of this genus are very difficult to determine satisfactorily; the Socorro examples were examined by Prof. Baird, who states that they are probably the species above named, as they agree quite well with the descriptions given of them.

## PELECANIDÆ.

14. **Pelecanus fuscus** Linn. "Brown Pelican."

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Among the papers relating to Socorro, I found the description given below of a new lizard, by Prof. E. D. Cope; on communicating with him concerning it, he replied that no account of it had ever been published, consequently it now appears for the first time.

## Description of the Common Lizard of Socorro.

By E. D. Cope.

**Uta auriculata** Cope.

Scales above minute, except six carinate, dorsal rows, of which the median of each three is larger than the others; these increase towards the rump and diminish anteriorly. Abdominal scales smooth, in twenty-three rows. A dorso-lateral, dermal line on each side is covered by rounded scales larger than those of the adjacent regions. Two pair supranasal plates; four internasals, the posterior large as the rest combined, and equal anterior division of the two, into which the prefrontals are divided, and which lie on each side of it. Frontal transversely divided. Interparietal larger than parietals, a little longer than broad. Temporal region granulated; a crest of short acute scales on the ridge of the os quadratum above the large tympanum.

Total length (tail reproduced) 6.90 inches; end of muzzle to vent, 2.90; length of hind foot, .92 inches; muzzle to posterior margin tympanum, .70; width cranium at supratympanic crest, .45 inches.

Color blue above, with eight pairs of black spots between scapular and crural region, which are more or less connected across the median line. Another series of black spots alternating on the sides. A large black crescent on scapula on each side; gular region cross-banded with blackish.

This is the seventh species of this genus now known, which all belong to the Sonoran district, though two of them, *U. ornata* Bd.; and *U. Stansburiana* Bd., Gird., occur in Texas.

Note. Specimens of the only land mollusk collected at Socorro by Colonel Grayson, were submitted through the Smithsonian Institution to Mr. Thos. Bland, who determined the species to be *Orthalicus undatus* Brug. From the note by Col. Grayson on the species found at the Tres Marias, Mr. Bland infers it to be the same as that from Socorro.

Dr. Brewer said that among the birds from Wisconsin, purchased of Mr. Kumlien, is a species of Empidonax, parent birds with nest and eggs, identified as *E. pusillus* by Prof. Baird. This species had not before been seen east of the Rocky Mountains, over one thousand miles west of the locality where it is now found breeding. The differences

in the nest and eggs from those of *Empidonax Traillii*, and all other species of the genus, indicate that *E. pusillus* is a good species and not merely a variety of the former.

Dr. B. Joy Jeffries, by the aid of diagrams, illustrated the unity of design in the eyes of animals which he had referred to at the preceding meeting; he also explained the causes of color-blindness.

Dr. Farlow exhibited the Algæ collected by Mr. Chas. Wright, in the late San Domingo expedition, thirty-five species, of which twenty-five had been collected by Mr. Wright in Cuba also. Dr. Farlow remarked that it was singular that among the many specimens of Sargassum no specimen of *S. bacciferum*, the true gulf-weed, was to be found. He also referred to the ill-defined characters of this large genus. *Turbinaria vulgaris*, found also in Jamaica, forms an interesting connecting link between Sargassum and Fucus.

The thanks of the Society were voted to the Trustees of the Mt. Auburn Cemetery for the gift of a Trumpeter Swan.

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Section of Microscopy. June 14, 1871.

Mr. Bicknell in the chair. Nine members present.

Mr. Bicknell showed some paper cells made by him in a very simple manner. A number of layers of card-board of the desired thickness are clamped together, and holes are bored with a spur-bit through the whole thickness, at a convenient distance apart. The card is then pressed smooth and finally cut up.

Mr. Stodder exhibited a slide containing *Stauroneis Stodderii* Greenleaf, from Lyman's Pond, Waltham, collected by

Dr. Warren, a diatom which has not before been found outside of New Hampshire and Maine.

Mr. Greenleaf remarked that his types came from Bemis Lake, N. H.

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June 21, 1871.

The President in the chair. Twenty-nine persons present.

Mr. W. H. Dall made some remarks on the geography of the Aleutian Islands, which have been as yet only imperfectly explored, and stated that an expedition to them in charge of the Coast Survey was intended, with which he was to be associated. Mr. Dall also referred to the differences between the walrus of the Atlantic and Pacific Coasts, which he considered as varieties of one species, and described the habits and commercial importance of these animals.

The President read an article on Silica. He showed the almost universal presence of this mineral, its beauty under many forms, and its great economic value. He exhibited a beautiful crystal globe, six inches in diameter, of Japanese manufacture, which Mr. Thos. Gaffield had lent him for the occasion.

Dr. Chas. T. Jackson called attention to the occurrence of crystal globes in the Druid Mounds of England, which are of an oblate-spheroidal form, and about the size of an orange. He thought the Druids must have obtained the material from Japan or other equally remote place, as no locality for it is known nearer England.

Dr. Thos. Dwight gave a brief account of his work in the preparation of the skeleton of the whale for the Society's Museum.

The whale is an example of the *Balænoptera musculus, or Physalus antiquorum*, although there are so many small peculiarities that many observers would be inclined to make it a new species.

There are sixty-three vertebræ, fifteen of which are dorsal. The last rib on the right side had an ununited fracture, and many others on the same side bore an anomalous protuberance near the head of the rib, which was very suggestive of injury. The animal was briefly described and thoroughly measured before dissection by Mr. J. A. Allen, and drawings were made by Mr. J. H. Blake, both of the Museum of Comparative Zoology. These drawings and notes have been put very handsomely at my disposal by Mr. Allen.

The length was 48 ft. The circumference of the head at the eye, 23 ft. 8 in. The magnitude of the dissection and the decomposed state of the carcase, prevented any careful examination of the soft parts, but the skeleton is very complete. Both pelvic bones, each with a rudimentary femur have been preserved, as well as all of the bones of the hyoid apparatus.

It is hoped that the skeleton will be mounted in the course of a few months, and it will be minutely described in the Memoirs.

Dr. C. T. Jackson read the following final report on the Frozen Well in Brandon, Vt., in behalf of the committee appointed to investigate the phenomenon.

### REPORT ON BRANDON FROZEN WELL.

Twelve years ago Mr. John H. Blake called the attention of this Society to the curious fact of the existence of a well of water in Brandon, Vermont, which remained frozen throughout the summer months, and a Committee was appointed to make an examination of this singular phenomenon.

Uriah A. Boyden, Esq., of this city generously placed in the hands of this Committee the sum of three hundred dollars, to defray the expenses of their examination of this matter. The Committee consists of the following gentlemen: William B. Rogers, John H. Blake, Charles T. Jackson, and subsequently Thomas T. Bouvé.

Owing to other engagements some members of the Committee were unable to visit the Frozen Well, but Messrs. Blake and Jackson have steadily devoted their attention to the subject, Mr. Blake performing by far the largest share of the work, while he was resident in Brandon in charge of his iron and paint mines.

The first explorations made by the Committee were on the 10th of June, 1859, and they continued each year to visit and examine the Frozen Well and the surrounding country for six years, and they

made a very full report of their explorations to the Society, which report is published in the number of the Proceedings for the month of May, 1862, pages seventy-two to eighty-seven.

They would gladly have closed their examination at that time, but owing to the prediction made by a very eminent man of science, Prof. Loomis, that the ice would soon cease to form in the Brandon well, it was thought best to wait a few years to see if this prediction would come to pass. We have now to report that for twelve years the ice has remained in the Brandon well during the hot months of summer, and that notwithstanding the openings we have made in the soil, and a tunnel into the gravel bed near to the well, giving more free access to warm surface water, the ice does not diminish in the well.

Even the cutting away of the Hogback gravel hill nearly to a level with the ground around the well, has not caused the heat to penetrate sufficiently to melt the ice hoop that clings to the stones just above the surface of the water, and it remains as it was when we first visited the place. It seems that the wave of heat is still unable to overcome the intense cold of the gravel bed.

Among the suggestions thrown out by some who have attempted to solve the problem of the frozen well is the idea, that the water dissolves something from the rocks that makes it a freezing mixture. This conjecture is disproved by the chemical analysis of the water.

### Chemical Analysis of the Water of Brandon Frozen Well. By C. T. Jackson.

One wine gallon of this water contains 25.2 grains of solid matter, which was resolved into

| | *grs.* |
|---|---|
| Vegetable matter | 6.80 |
| Mineral salts | 18.40 |
| | 25.20 |

Of this, 2.8 grains forms an adhesive crust on the capsule in which the evaporation took place, and consists of carbonates of lime, magnesia and iron, derived from their bi-carbonates.

The water was found to contain bi-carbonates of lime, magnesia and iron, sulphate of soda and a little chloride of calcium and of sodium.

There is nothing in its composition that will explain its freezing any more readily than other water.

Others have imagined that electricity had something to do with the freezing, taking the idea probably from the fact that electricity favors, if it does not actually cause, hail.

The difference of the cases is very decided. In the atmosphere there may be, and doubtless are, highly electrified particles electrified with the same kind of electricity so as to act as repellants to each other, and thus is caused expansion of the air, absorption of latent heat, and consequent cooling, so as to cause moisture to congeal into ice. Liquid water, being a pretty good conductor of electricity, could not be thus operated upon by electricity, and so no freezing could result even if the water should be electrified. In order to settle the question as to the existence of currents of electricity, both Mr. Sawyer and myself ranged squares around the well and tested the direction of the magnetic needle, and found no difference or local variation, showing that no perceptible electric current was taking place in the well or in the soil around it.

We are therefore forced to recur to our original explanation, that the gravel bed was frozen by the cold of former rigorous winters, and that the wave of heat has not yet been able to overcome that cold. Whether it ever will do it is a problem to be solved only by time, but we think our numerous pits sunk into the gravel bed will hasten the thawing.

Since your Committee reported the results of their former examination, Mr. Boyden sent Mr. Sawyer, a civil engineer, to make a topographical survey of the premises, and to sink some new shafts around the frozen well. Mr. Boyden has also himself visited the locality and made a careful examination, and can suggest to the Committee no new or additional experiments or researches, and it is therefore the wish of the Committee to close their examination, and to ask to be discharged from further consideration of the subject.

The expenses attending the examinations of the Brandon frozen well from June 10, 1859 to the completion of our labors, was $270.07, there remaining a balance of the $300 of $29.83, which was returned to Mr. Boyden, with a detailed account of our expenditures.

Mr. Bouvé presented the report of the Committee on the Walker Prizes. Three papers had been received. A first prize was awarded to Prof. Albert N. Prentiss, of Ithaca, N. Y., and a second to Mr. Daniel Milliken, of Hamilton, Ohio. The report was accepted.

Mr. Sanborn called attention to the gifts upon the table, among them the skull of a walrus, presented by Capt. E. T.

Fish, for which the thanks of the Society were voted to the donor.

A paper was read by title "Observation on the Surface Geology of North Carolina, by L. S. Burbank."

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## INTERMEMBRAL HOMOLOGIES. BY BURT G. WILDER, M.D.

*Continued from p.* 188.

### IV. THE MORPHOLOGICAL UNIMPORTANCE OF NUMERICAL COMPOSITION.

The familiar fact that with most Mammalia the pollical and primal phalanges are only two in number, while the other digits and dactyls possess three, forms the chief difficulty with those who are asked to consider pollex the meketrope of quintus and primus that of minimus; and it forms the only difficulty with those who have already recognized the fallacy of the objections generally urged upon the ground of the *size* and *natural attitude* of the parts; evidently then, the removal of this difficulty is of the utmost importance.

Here, as generally throughout this paper, the facts and conclusions will be given with reference to the Mammalia; partly because that class has afforded me the most material, but chiefly because the three grand difficulties already mentioned are especially manifest in the higher vertebrates; and I am convinced that they never would have prevented our recognition of meketropy in the membra, had we been lizards or turtles instead of primates.

It cannot be denied that some significance must attach to numerical composition of organs; since, aside from the symbolic character which many believe them to possess, the very constancy of numbers is a remarkable fact in Natural History. But for the general rule that the mammalian cervix consists of seven vertebræ, it is probable that no effort would be made (as by Thomas Bell, Trans. Zool. Soc., vol. 1)to show that *Bradypus tridactylus* has but seven, instead of nine, as believed by Turner and Owen; and there would be nothing strange in the fact that *Cholœpus Hoffmanni* has but six cervical vertebræ; on the other hand, the value of this as even a generic character seems to be destroyed by the fact, that another species of the same genus (*C. didactylus*) has the usual number.

Again, it is stated by Mosely and Lankester, that the mole is the only placental mammal with eight intermaxillary teeth; and the ex-

ception is equally inexplicable with those of the vertebræ, since that animal shows comparatively little more affinity with the marsupials, than the sloth shows to the birds.

Again, it is stated by Argyll (204, 223) that the number of tail and wing feathers is constant throughout the Trochilidæ, although 430 species are already known.

Finally, the constancy in the number of mammalian digits is so absolute, that not only do we exclude from the category all "sixth fingers and toes," but we give no heed to the ossicle which projects from the ulnar border of the carpus in Chelone (63, 1, 173) and in many Cetacea (63, 2, 427), and call it "pisiform," although it looks as much like a digital metacarpal as some which are generally accepted as such; and, indeed, so convinced are we that five is the maximum normal number of these parts, that we hardly wonder to find that the required expansion of the manus with the mole and the Yapock opossum is gained, not by the addition of a sixth digit, but by the excessive development of a carpal ossicle.

We must admit, therefore, that numerical composition means *something*; perhaps more in some cases than in others; *how much* it means is difficult to determine; probably, however, not as much as relative normal position.

The following citations from authors are sufficient to show the present obscurity of this subject.

"The examination of the skeleton (of fishes) has led to the conclusion that the number of vertebræ is another character of great importance for the distinction of families; but whether it has any bearing of still greater import, cannot be exactly determined at present.[1]

Owen says, (63, 1, 42), "The number of trunk vertebræ is useful as a specific character in Icthyology."

Agassiz writes as follows (200, 4, 64), respecting the zoological importance of this attribute with radiates; "I would remind the reader of the little value which *numerical differences* undoubtedly have in this question, notwithstanding the constancy of the number of parts in most of the radiates; for though the number five is the typical number among echinoderms, there are crinoids and starfishes and even echinoids, with four and six spheromeres, and others with an unusually large number; and though the number four and its

[1] Gunther; Cat. of Acanth. Fishes, 1861, Preface.

multiples are the typical numbers of acalephs, we find those which have five or six spheromeres and other numerical combinations. We need not therefore hesitate to compare an Aurelia with a quadripartite and an Echinarachinus with a quinquepartite arrangement of parts;" again, (200, 4, 379) "as soon as we can free ourselves from the belief that histological complication and structural differentiation are positive tests of homological relationships, and as soon as we allow full weight to embryological evidence, the close affinities of the echinoderms and the other classes of radiates becomes self-evident."

Spencer uses the following very suggestive language, which I accept as true, omitting his conclusion as to the *cause* of the superinduced segmentation, (299, 2, 110); "The parts composing the supposed archetypal vertebræ" (of Owen) "are constant neither in their number nor in their relative" (natural) "position, nor in their modes of ossification, nor in the separateness of their several individualities when present; . . . . everything goes to show that the segmental composition which characterizes the apparatus of external relation in most vertebrates is functionally determined or adaptive."

Finally, Thomas Bell remarks, "the laws which regulate the numerical variations in the different systems of organs in an animal, are perhaps less defined or at least less understood than those which relate to many other conditions of their existence."[1]

Coming now to our special point, we may enumerate the morphical relations of the digits as follows, taking the medius for an example, since there has never been a doubt respecting its homology with tertius, and both these are present in every known manus.

1. Its special or plural homology with the medius of other Mammalia. (Fig. 2, A-B)

2. Its single, serial and longal homology or *mekesyntropy*, with its fellow-digits of the same manus. (C-D).

3. Its single and vertical homology, *hypsetropy* with the medius of an individual of the opposite sex. (E-F).

4. Its single and lateral homology, *platetropy* with the medius of the opposite side. (G-H).

5. Its single and longal homology, *meketropy*, with the middle dactyl, tertius. (G-I).

Now although all these five relations are between a single digit and another digit or dactyl, yet the relations of the several regions

[1] Trans. Zool. Soc., vol. I, p. 133, 1833.

or surfaces of the digits compared are quite distinct, as shown by the figure. In plural homology and in mekesyntropy, the premembral surface of the one corresponds to that of the other, the dorsal surface of the one to that of the other as if both occupied the same place, or were merely superposed, as with geometrical comparisons of similar figures; but with the three antitropical homologies, corresponding parts look in opposite directions; so that with platetropy, the right and left digits are as if placed base to base, or tip to tip, with hypsetropy as if placed back to back or palm to palm, and with meketropy as if placed side by side; but the two *contiguous* surfaces then correspond. In case the normal position of the membra should be determined to be other than it is here assumed to be, a corresponding change would be made with the surfaces compared together; for instance, if the digits were made to point backward and the dactyls forward, their bases and tips would be related meketropically instead of platetropically, while their opposite sides would be related platetropically instead of meketropically; and although this would be a matter of little consequence as regards a single and simple part like a digit, yet when we have to compare such parts as tarsus and carpus, and muscular organs, misunderstanding can be avoided only by regarding the membra as always in the same normal position.

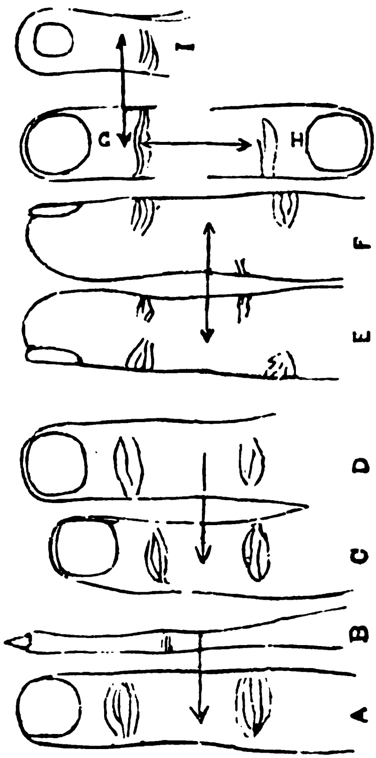


Fig. 8.

Now since these five relations above described, however they may differ among themselves as to the particular regions of two parts which are compared together, are all relations of *homology*, it may probably be taken for granted that whatever criteria are accepted for one kind of homology, are equally applicable to the rest; excepting, of course, the tropical relations which depend upon the position of the parts with reference to the axis of the body. If this is granted, then, we are entitled to employ the arguments used in deciding any one of the relations upon which there is now no dispute, in determining those now under consideration.

For instance, the tertius of a seal is determined to be the plural homologue of the middle dactyl of a rhinoceros, not from its size or function, but from its relative position in the pes; the tertius of man is held to be the meketrope of the medius, from their similar relative position, although the one is a short dactyle, and the other is the longest digit; again, the primus of man is held to be homologous with the primus of a bat, although they differ not only in size and function, but in their apparent relative position, since the human primus is on the inner border of the pes, and that of the bat becomes the "outer toe" through the complete eversion of the skelos; we here see that relative normal position is of superior morphical value to size, function, and natural attitude; finally, the homology between the human primus and that of an orang has never been questioned, although the latter often, if not generally, consists of but a single phalanx; the homology between the minimus of an ordinary mammal and that of a bat has never been denied, although the latter rarely, if ever, consists of the usual number of phalanges; no one has even doubted the entire homology of the five digits of many tortoises, (Ow., 63, 1, p. 173) with those of the Mammalia, as is shown by the use of the same names (pollex, etc.,) yet none of the former have more than two phalanges; a like discrepancy exists with the birds; and, if, as I am willing to admit, it is better to confine the comparisons to the Mammalia, an even more striking case is offered by many Cetacea, where the digits are enumerated from one to five, (or styled pollex, etc.,) and where the subdivisions of the digits are invariably called phalanges, although in some cases, as in the round-headed dolphin, (*Globiocephalus melas*), the medius may possess eight and the index twelve of them, and although the form, function, and attitude of the entire manus be unlike that of man.

It appears therefore, that in the determination of all kinds of ho-

mologies, the relative normal position has been found to be of greater morphical value than size, than function, than natural attitude, and finally than even numerical composition; and yet, when we ask anatomists to consider the other evidences of meketropy, which are presented by the development and structure of the body, and show that even the adult membra offer no difficulties in their proximal portions, and that in the embryo, no difference of size or segmentation exists in the manus and pes, they hold to the syntropical comparison, partly because of its antiquity and general acceptation; partly because of the similarity of pollex and primus in that morphological anomaly, the human body; partly because in the natural attitude of the manus with quadrupeds, the pollex becomes the inner digit like the primus; but chiefly because with many Mammalia pollex and primus differ in numerical composition from the other digits and dactyls: and this in spite of the fact that for the determination of every other case of homology, all these considerations have been set aside in favor of the single character, relative normal position.

In reference to this question, some other facts and arguments should be considered.

1. That with most members of the group called Perissodactyla, (Ow., 62, 2, 283; Fl., 71, 3,) including the existing genera Rhinodceros, Hyrax, Tapirus, and Equus, and many extinct genera, the pollex and minimus, the primus and quintus are wanting,[1] so that, were the problem to be decided for them alone, no objection would arise respecting these outer digits and dactyls; and the argument that such a question cannot be decided upon evidence drawn from a single group, applies with equal force to the consideration of the Mammalia alone out of all the vertebrate branch; and, as has been already stated, the objection derived from the numerical composition of certain digits and dactyls, would never have arisen among the members of the lower classes of vertebrates.

2. That it is not yet determined whether the so-called pollical metacarpal (⊿ pollicis) and primal metatarsal (⊿ primi) should not be regarded rather as proximal *phalanges* of the pollex and primus, as Oken (284, Par. 2382) and Maclise (23, 663) are inclined to believe; this view is not obviously inconsistent with the observations of Thomson and Humphrey (305) upon the mode of ossification of these parts, and Flower admits (71, 255) that the question is not decided.

[1] Tapirus retains the minimus and Hyrax the minimus and a rudimentary pollex.

3. That in a few cases, the human pollex has consisted of three phalanges, and so resembled the other digits and the quintus; such a case figured by Annandale,[1] who adds that he has met with others; Dubois describes a case[2] which is referred to by Fort[3]; and in the Cabinet of the Boston Society for Medical Improvement, is a plaster cast of another case which came under the observation of Dr. B. E. Cotting, and was described by Dr. J. B. S. Jackson.[4] Dr. Fort mentions other instances of an unusual increase or decrease in the number of digital phalanges.

4. That all the digits and dactyls may possess less than three phalanges, as in Chrysochloris, while in Cetacea all of them may possess more than that number.

5. That in many Mammalia the number of minimal and quintal phalanges is less than three; which removes, so far as those species are concerned, the objection to homologizing minimus and quintus with primus and pollex; the following list gives the species, the number of phalanges, and the authority for the statement; no reference is made to the many species in which the minimus and quintus are wholly wanting, or represented only by a metacarpal or metatarsal. The Cetecea are enumerated in a separate table, since their digital phalanges generally vary from the usual number with Mammalia.

| | | |
|---|---|---|
| | POLLEX. | |
| Ateles. | 1 or 0 | Fl., 71, 258. |
| Colobus. | 1 | " " |
| Elephas. | 1 | Hum., 86, 5. |
| | INDEX. | |
| Perodicticus. | 2 | Fl., 71, 258. |
| Arctocebus, | 2 | Miv., 276, 825. |
| Cheiroptera (generally). | 2 | Fl., 71, 262. |
| Chrysochloris. | 2 | Miv., Journ. of Anat. and Phys. 2, 133. |
| | MEDIUS. | |
| Chrysochloris. | 2 | Miv., Journ. of Anat. and Phys., 2, 133. |
| Pteropinæ. | 2 | Fl., 71, 262. |
| | ANNULARIS. | |
| Cheiroptera, (generally). | 2 | Fl., 71, 262. |

[1] Malformation of fingers and toes; p. 29; pl. ii, fig. 19.
[2] Archives de Medicin, Apr., 1826.
[3] Difformités des doigts, p. 59, 1869.
[4] Catalogue of Museum of Med. Imp. Soc., p. 871.

MINIMUS.

| | | |
|---|---|---|
| Cheiroptera (generally)[1]. | 2 | Fl., 71, 262. |
| Chrysochloris. | 2 | Miv., J. of A. and P., 2, 133. |
| Rhynchocyon. | 2 | Ow., 63, 2, 390. |
| Hyrax dorsalis.[2] | 2 | Fl., 71, 293. |
| Periodontes (Dasypus) sexcinctus. | 2 | Ow., 63, 2, 408; Fl., 71, 277. |
| Megatherum Americanum. | 2 | Ow., 63, 2, 412. |
| Myrmecophaga jubata. | 2 | Ow., 63, 2, 410. |
| " didactyla. | 2 | Fl., 71, 275. |

*Table giving the number of digital phalanges with some species of Cetacea.*

| *Species.* | P. | I. | M. | A. | Min. | *Authority.* |
|---|---|---|---|---|---|---|
| Balæna mysticetus | 0 | 3 | 4 | 3 | 2 | Esch. and Reinh: Ray Soc. Mems., 129. |
| Balænoptera Bonærensis | 0 | 4 | 3 | 2 | 2 | ? Proc. Zool. Soc., 1867, 712. |
| " musculus | 0 | 5 | 6 | 7 | 4 | Lillej. Ray Soc. Mems. 260. |
| " laticeps | 0 | 3 | 6 | 5 | 2 | " " " " 271. |
| " rostrata | 0 | 4 | 7 | 6 | 3 | " " " " |
| " " | 0 | 3 | 7 | 6 | 4 | " " " " |
| Physalus antiquorum | 0 | 4 | 5 | 5 | 3 | Flow. Proc. Zool. Soc., ? 1864, 413. |
| " " | 0 | 2 | 7 | 6 | 3[3] | Flow. Proc. Zool. Soc. 1864, 413. |
| " sibbaldii. | 0 | 4 | 5 | 5 | 3 | Flow. Proc. Zool. Soc. 1865, 473. |
| Sibbaldius ? | 0 | 3 | 3 | 6 | 3 | Flow. Proc. Zool. Soc. 1864, 398. |
| Catodon macrocephalus | 3 | 4 | 4 | 4 | 3 | Gray, P. Z. S. 1864, 233. |
| Physeter " | 1 | 5 | 5 | 4 | 3 | Fl. T. Z. S. v. pl. 61. |
| " (euphysetes) simus | 3 | 6 | 4 | 3 | 3 | ? T. Z. S. vi., pl. 2. |
| Euphysetes ? | 0[4] | 7 | 5 | 5 | 4 | Burmeister, P. Z. S., 1866, p. 712. |
| " grayii | 2 | 5 | 4 | 4 | 2 | Owen, T. Z. Soc. vi., p. 43. |
| Delphinus orca | 2 | 6 | 4 | 3 | 2 | Esch. Ray Soc. Mems., 178. |
| " sinensis | 0 | 6 | 5 | 2 | 1 | Flow. T. Z. S., vii., 158. |
| " leucas | 1 | 5 | 4 | 3 | 3 | Lillej. Ray Soc. Mems., 248. |
| " griseus | 2 | 8 | 7 | 2 | 1 | Cuv; qu. in Ray Mems., 214. |
| Globiocephalus (?) | 4[5] | 14 | 10 | 3 | 2 | Reinh. Ray Soc. Mems., 218. |
| " mel as | 3 | 12 | 8 | 2 | 0 | Flower, 71, 271. |
| Clymene similis | 2 | 7 | 8 | 7 | 0 | Gray, P. Z. S. 1868, 148. |
| Inia Geoffroy ensis | 0 | 5 | 4 | 2 | 2 | (?) T. Z. S. vi, pl. 25. |
| Orca (?) | 2 | 7 | 4 | 3 | 2 | Reinh. Ray Soc. Mems., 214. |
| " gladiator | 1 | 6[6] | 4 | 3 | 1[7] | Lillej. Ray Soc. Mems., 234. |
| " schlegellii | 1 | 5 | 3 | 2 | 1 | Lillej, Ray Soc. Mems., 237. |
| Pseudorca crassidens | 2 | 7 | 6 | 3 | 2 | Reinh. Ray Soc. Mems., 218. |
| Pontoporia Blainvillii | 0 | 6 | 6 | 3 | 2 | Burm. P. Z. S. 1867, 487. |
| Hyperodon rostratus | 1 | 6 | 5 | 2 | 1 | Lillej. Ray Soc. Mems., 248. |

[1] Mystacina has three according to Tomes.
[2] *Hyrax capensis* has the usual number.
[3] These digits were articulated artificially, so the observer had some doubts respecting the number of phalanges.
[4] The figure (from a photograph) does not show clearly whether there is a phalanx attached to the metarpal pollicis.
[5] The left pollex had three phalanges.
[6] The index may have had seven and the minimus two.

The foregoing tables are suggestive of some other considerations bearing more or less directly upon intermembral homologies.

1. From the nature of the parts, especially in Cetacea, and also from the admissions of some observers, it is not always easy to ascertain the number of digital phalanges; it appears also, that the possible morphical value of such information has not always been recognized by observers, by reason of the slight telical importance of the individual phalanges; but on the other hand, some have been so accurate as to note a difference in the numerical composition of the same digit upon the two sides of the body: (as with the Globiocephalus described by Reinhardt).

2. The distinctions between metacarpals and phalanges, in respect to length and mobility, which exist with the higher Mammalia, do not appear with the Cetacea; with *Glob. swineval*, according to Macallister, (P. Z. S., 1867, p. 481), the exact "number of phalanges could not be reckoned," and the only synovial capsule was at the omos; and in describing the armus of *Balæna mysticetus*, Eschricht and Reinhardt state that the minimus "is in direct contact with the ulna," . . . and they are led to suppose that "not only the carpus and digits, but also the bones of the forearm have all been formed in the beginning from one continuous cartilage, and that, at all events, we cannot here expect fixed or quite immutable relations between individual bones." (Ray Soc. Mem., p. 131.)

3. While there seems to be no objection to admitting the special homology of the cetacean *digits* with those of other Mammalia, there appears to be no way of determining the special homology of individual phalanges even within the Cetacea themselves; for, allowing a margin for inaccuracies of observation and statement, there is nevertheless a considerable discrepancy in this respect between members not only of the same order and family, but also of the same genus (*Delphinus*, for instance) and species (*Physalus antiquorum*).

4. The taxonomic value of the numerical composition of the digits must be regarded as very low with the Cetacea; it may be said that this conclusion would not necessarily apply to the other Mammalia, but it would not be easy to prove this, since they are members of one and the same class; the Cetacea do not present exactly the case of the Cheiroptera, because the usual number, three, is never exceeded in this group, and although it is not now certain which of the phalanges is missing, yet there appears to be no reason why this matter may not some time be decided; but I see no way of ascertain-

ing the special homology between the twelve indical phalanges of *Globiocephalus melas* and the three of an ordinary mammal.

5. It might be thought that such lack of special homology between the cetacean digits and that of other Mammalia, indicated the propriety of regarding the former as forming a subclass; but this at once brings up another consideration.

NUMBER OF VERTEBRÆ.

The number of vertebræ (excepting the cervical), differs greatly among the ordinary Mammalia, as is stated in all works upon comparative anatomy; from various authorities, chiefly Owen, 63, 2, and Flower, 71, I have prepared a table showing the number of cervical, thoracic, lumbar, sacral and caudal vertebræ of many species of Mammalia, (105 species representing 91 genera); the cervical vertebræ are seven in all excepting in *Manatus* (6) and *Cholœpus Hoffmanni* (6) and *Bradypus tridactylus* (9); but there is evidently room for different interpretations of the facts in these cases.

The same is the case with the enumeration of the sacral and caudal vertebræ, but the variations in their number are so great and so generally recognized that a tabular statement is not required in this connection. I wish here, however, to ask whether the immense elongation of the tail in many species is primordial or secondary; and if the latter, whether the increase is by gradual development of new segments or by the increase in size of some which are formed all together at the front; upon the answer to this question, might be based a discrimination between the segments which immediately succeed the sacrum, and have the *structure* of vertebræ, and those more simple cylinders of bone which have no claim to the title of vertebra beyond their serial relation to the former.

In any case, the numerical variation of a peripheral part like the tail, would not have a greater morphical significance than that of the phalanges.

But with the so-called *trunk vertebræ* the case is very different; they are the central portion of the skeleton, whether from side to side, from back to belly, from head to tail; and there is no obvious reason why their number should not be constant, or at least as much so as that of the cervical vertebræ, since the degrees of mobility required of the latter in different species, are far more numerous and decided than appear to be required from the trunk; yet no such constancy

exists, even with species of the same family and genus, as is shown by the following table of the thoracic and lumbar vertebræ. The conflicting statements of different authorities may be due to a different interpretation of facts, but I am quite prepared to suppose that in some cases, really individual differences existed between the specimens examined.

*Table showing the number of trunk-vertebra with Mammalia.*[1]

LEMURIDÆ.

| | D. | L. | | |
|---|---|---|---|---|
| Tarsius spectrum | 13 | 6 | 19 | Owen. |
| Perodicticus Potto | 16 | 6 | 22 | " (or 15-7,—22). |
| Stenops gracilis | 15 | 9 | 24 | " |
| " tardigradus | 16 | 8 | 24 | " |
| Otolicnus peli | 13 | 7 | 20 | " |
| " crassicaudatus | 13 | 6 | 19 | " |
| Lichanotus Indri | 13 | 8 | 21 | " (or 12-9,—21). |
| Loris | 14 | 9 | 23 | Miv. (or 15-9,—24). |
| Cheiromys madagascariensis | 13 | 6 | 19 | Owen. |
| Arctocebus | 15 | ? | | Mivart. |
| Nycticebus | 16 | 8 | 24 | " |
| Hapalemur | 12 | 7 | 19 | " |
| Microcebus pusillus | 13 | 7 | 20 | " |
| Cheirogaleus millii | 13 | 7 | 20 | " |
| Lemur (?) | 13 | 6 | 19 | Owen. |

CARNIVORA.

| | D. | L. | | |
|---|---|---|---|---|
| Canis (lupus, rufus and familiaris) | 13 | 7 | 20 | Owen. |
| Ursus (generally) | 14 | 6 | 20 | " |
| " labiatus | 15 | 5 | 20 | " |
| Hyæna vulgaris and crocuta | 15 | 5 | 20 | " |
| Felis (generally) | 13 | 7 | 20 | " |
| Procyon lotor | 14 | 6 | 20 | Flower. |
| Nasua | 14 | 6 | 20 | " |
| Meles | 15 | 5 | 20 | " |
| Phoca grœnlandica. | 15 | 5 | 20 | Owen (or 14, 5,—19). |
| Stenorrhynchus serridens | 15 | 5 | 20 | " |
| Otaria | 15 | 5 | 20 | Flower. |
| Crystophora | 15 | 5 | 20 | " |
| Callorrhinus ursinus | 15 | 5 | 20 | Allen, J. A. |
| Eumetopias Stelleri | 15 | 5 | 20 | " |
| Putorius erminius | 14 | 6 | 20 | Owen. |
| Mustela zibellina | 14 | 6 | 20 | " |
| Trichecus rosmarus | 15 | 5 | 20 | " |
| | | | | |
| Mephitis | 16 | 6 | 22 | |
| Mellivora | 14 | 4 | 18 | |

[1] The materials are drawn chiefly from four works; Owen, 68, 2; Flower, 71; Mivart, Osteology of the Insectivora, Journ. of Anat. and Phys.; and Mivart, Ost. of Lemuridæ, Proc. Zool. Soc., Dec. 12, 1867.

INSECTIVORA.

| | D. | L. | | |
|---|---|---|---|---|
| Erinaceus | 15 | 6 | 21 | Flower. |
| Talpa europæa | 16 | 6 | 22 | " |
| Sorex | 15 | 6 | 21 | Mivart (or 13-5—18). |
| Centetes | 19 | 5 | 24 | Owen. |
| Tupaia | 13 | 5 | 18 | Flower. |
| Macroscelides | 13 | 7 | 20 | Owen. |
| Chrysochloris | 19 | 3 | 22 | Flower. |
| Potomogale | 16 | 5 | 21 | Mivart. |
| Echinops | 16 | 6 | 22 | " (or 17-5—22). |
| Rhynchocyon | 13 | 8 | 21 | " (quot. Peters). |
| Gymnura | 15 | 5 | 20 | " |
| Scalops | 14 | 5 | 19 | " |
| Urotrichus | 13 | 7 | 20 | " |
| Myogale | 13 | 6 | 19 | " (or 14-5—19). |
| Galeopitheous [1] | 14 | 5 | 19 | " |
| " | 14 | 6 | 20 | Owen (or 13-7—20). |

CHEIROPTERA.

| | D. | L. | | |
|---|---|---|---|---|
| Vespertilio murinus | 12 | 7 | 19 | Owen. |
| Pteropus fuscus | 14 | 5 | 19 | " |

ARTIODACTYLA.

| | D. | L. | | |
|---|---|---|---|---|
| Sus scrofa | 13 | 6 | 19 | Owen. |
| Dicotyles | 14 | 5 | 19 | " |
| Hippopotamus amphibius | 15 | 4 | 19 | " |
| Camelus bactrianus | 12 | 7 | 19 | " |
| " dromedarius | 12 | 7 | 19 | " |
| Auchenia | 12 | 7 | 19 | " |
| Bos taurus | 13 | 6 | 19 | " |
| " europæus | 14 | 5 | 19 | " |
| " americanus | 15 | 4 | 19 | " |
| Moschus moschiferus | 14 | 5 | 19 | " |
| Ovis | 13 | 6 | 19 | " |
| Cervus tarandus | 14 | 5 | 19 | " |
| Camelopardalis giraffa | 14 | 5 | 19 | " |
| Antelope equina | 14 | 6 | 20 | " |
| Chousingha | 13 | 5 | 18 | ? |

PERISSODACTYLA.

| | D. | L. | | |
|---|---|---|---|---|
| Equus caballus | 19 | 5 | 24 | Owen. |
| " zebra | 18 | 6 | 24 | " |
| " quagga | 19 | 6 | 25 | " |
| " asinus | 18 | 5 | 23 | " |
| Tapirus americanus | 18 | 5 | 23 | " |
| Rhinocerus indicus | 19 | 3 | 22 | " |
| Elephas indicus [2] | 20 | 3 | 23 | " |
| Hyrax capensis | 22 | 8 | 30 | " |

[1] The place of this genus appears yet undetermined.

[2] Huxley (78) and Gill regard this genus as forming a distinct *order*.

RODENTIA.

| | D. | L. | | |
|---|---|---|---|---|
| Hystrix cristata | 15 | 4 | 19 | Owen. |
| " alopha | 14 | 5 | 19 | " |
| Lepus timidus | 12 | 7 | 19 | " |
| Castor fiber | 15 | 4 | 19 | " |
| Fiber zibethicus | 13 | 3 | 16 | Flower. |
| Capromys | 17 | 6 | 23 | " |
| Loncheres | 17 | 8 | 25 | " |
| Hydromys chrysogaster | 14 | 7 | 21 | Owen. |
| Myoxus | 13 | 7 | 20 | Cuvier. |

BRUTA.

| | D. | L. | | |
|---|---|---|---|---|
| Dasypus peba | 10 | 5 | 15 | Owen. |
| Bradypus | 17 | 3 | 20 | Flower. |
| " | 15 | 5 | 20 | " |
| " tridactylus | 16 | 3 | 19 | Owen. |
| Manis | 13 | 5 | 18 | Flower. |
| " pentadactyla | 13 | 4 | 17 | Owen. |
| Myrmecophaga jubata | 15 | 3 | 18 | " |
| Orycteropus capensis | 13 | 8 | 21 | " |
| Megatherium | 16 | 3 | 19 | " |
| Cyclothurus | 15 | 2 | 17 | Flower. |

MARSUPIALIA.

| | D. | L. | | |
|---|---|---|---|---|
| Most genera | 13 | 6 | 19 | Owen. |
| Phascolomys wombat | 15 | 4 | 19 | " |
| " latifrons | 13 | 6 | 19 | Flower. |
| Phascolarctos | 11 | 8 | 19 | " |
| Petaurus macrurus | 12 | 7 | 19 | " |

After making due allowances for differences in the interpretation of facts by different observers, the preceding tables are very suggestive.

1. The different groups are seen to be unlike as regards the constancy of the vertebral formula; the adherence to 20, among the Carnivora (with but two exceptions so far as I know) is as startling as is the adherence to 7 with the cervical vertebræ; the number 19 is equally characteristic of the Artiodactyla; while in striking contrast to these two groups are the Perissodactyla and the Insectivora, which certainly do not differ widely enough in their habits from the Artiodactyla and Carnivora, to give a clue to the reason for these discrepancies.

2. Although in most cases, the species of a genus differ only by the greater or less development of the rib-process, so that the total number of thoracico-lumbar vertebræ is the same, yet in some cases, (Equus, Otolicnus, Loris, Sorex), this number varies by a single verte-

bra; it appears, also, that even individuals of the same species may vary in this manner, (*Phoca grœnlandica*); and this recalls a suggestion already made by me (45, 15), which ought to be considered, although, at present, its importance may seem rather ideal than real; "it does not seem possible that the head and pelvis can be as strictly homologous in animals having a different number of vertebræ as in those with the same number; in other words, the heads or the pelves of two animals may be cephalic or pelvic modifications of *vertebræ*, without being such modifications of the same identical vertebræ." Even if we exclude the skull from the category of vertebræ, the difficulty is not removed; for if the atlas of Hyrax is homologous with that of Elephas, then the sacrum of Elephas is the homologue of the twenty-fourth vertebra and its successors, with Hyrax; or if we also assume that the sacra of the two are homologous, we must homologize 29 vertebræ in the one with 22 in the other; and, *practically* at least, this seems to be our only course.

I trust that the foregoing considerations will aid in removing the stumbling block of numbers, from the path of those who would otherwise accept the meketropy of pollex and primus. To my own mind they were hardly needed, so decided was the conviction formed in 1866, and expressed in 51, 52 and 57, that no difference in the numbers of phalanges ought to affect our recognition of a profound morphological law affeoting the membra.

NOTE. Dr. Coues has kindly placed at my disposal the MS. of some unpublished investigations bearing upon this subject, which so nearly accord with my own views, that I add them here. April, 1872.

Susceptibility of variation in numerical composition he believes to be, *a*, in direct ratio of number of parts composing an organ, and *b*, in inverse ratio of morphical differentiation and telical specialization of the parts of an organ; and that, consequently, the *value* of numerical composition as a morphological or taxonomic datum can be estimated with reasonable confidence of at least approximate accuracy. Value is inversely as variability.

"It is notorious," he continues, "that an organ (whether central or peripheral — whether indispensable to the integrity of an animal, or merely a useful adjunct to its economy) composed of a few parts, does not exhibit the same percentage of variation in the number of these parts, as the same or a similar organ does when it is composed of many parts. For instance, the *normal* variation in the bones of the coccyx of Primates is at a minimum, if it be not, indeed, *nil*; whilst the ordinary individual variation in the coccyx of a longicaudate mammal, such as the *Jaculus hudsonius*, for example, amounts to four or five coccygeal vertebræ. The few dermal scutes of armadillos are sufficiently constant in number to afford specific characters, while the essentially similar but numerous

dermal scales upon the belly of a serpent may vary widely in number in different individuals of the same species. The rays of a small, sharply-outlined dorsal fin of a fish have no such variation in number as those composing a fin that extends the greater part of the length of the animal. The very numerous teeth of a serpent cannot be rendered with the certitude that attaches to the dental formula of a few-toothed mammal. In the lower families of birds possessing more than twelve rectrices, the number is fallacious even as a specific character, since it varies one or two pairs, at least, in different individuals of the same species, whereas in birds with eight, ten, or twelve rectrices these numbers mark whole familes, and the slightest variation is properly regarded as an anomaly. The few digital phalanges of birds are so constant (much more constant than their vertebræ) that deviation from the ordinary number becomes a character marking families.

"But it is unnecessary to dwell upon this obvious point, the more so since it is simply one part of the main proposition, that variation is greatest in organs composed of the most similar parts—parts that are essentially either morphically or telically *repetitive*, and conversely, that the variation in numerical composition is least in the structures made up of more perfectly differentiated or specialized parts. Any structure the essence of which admits of what is called 'vegetative repetition,' is susceptible of enlargement or curtailment by the development of more or fewer segments or moieties, and variability is a necessary result of such plasticity of organization. The examples adduced may be here cited again in illustration Most of the caudal vertebræ of a long-tailed mammal are precisely similar in form and function—positive duplicates of each other, and in such a mammal as the house-rat, the coccygeal formula can only be given approximately, while the still more numerous dermal annuli of the tail, though corresponding in a general way with the bones themselves, must be enumerated simply in round numbers. The vertebræ of a serpent, essentially similar throughout the long series, represent no such fixed number as those of a mammal where they are differentiated in several groups, each with its own character. And even surveying organs composed of few parts, we find striking differences in variability. The presence, in an animal possessing five digits, of a supernumerary one, is in frequency out of any calculable proportion to the appearance of two functional digits in an animal that, like the horse, has normally but one—perhaps the improbability of the latter is on a par with that of the appearance of ten digits in a man. I am not informed as to the individual variability in the number of phalanges of cetaceans, and probably too few of these animals have been dissected for correct estimation, but there is every reason to suppose that the liability to variation here is as much greater than it is an ordinary mammal, as the increase in the number of phalanges.

"The abrupt and marked increase in the number of phalanges of cetaceans as compared with ordinary mammals, and the imperfect discrimination of phalanges, metacarpals and carpals in these mammals, seem to be explicable upon the same principles that account for the great number, small size and mutual resemblance of the vertebræ of prehensile tailed mammals, and those that use a long flexible tail as a balance. There is the same teleology in either case—it is the production of perfect pliability; and in both, the increase seems to be sim-

ply a matter of repetition. It is probably as impossible to homologize individual bones of a cetacean manus with those of an ordinary mammal, as it is to homologize the immense number of caudal vertebræ of the genus Mus, for instance, with the few of a neighboring genus, Arvicola. In all such cases as these, where variability is at a maximum, the importance of numerical composition, either as a taxonomic or as a morphical character, is obviously at a minimum. If the Cetacea agreed with ordinary mammals in other respects, the composition of the manus would afford no better grounds for these wide separation than the number of caudal vertebræ in certain other families.

"If we take the other extreme, of a solidungulate animal, we find such strong differentiation of the osseous elements of the manus, that every single one of the few bones has its own shape and size, and each of the distal segments, at least, performs a perceptibly distinct function; even a sesamoid is elevated, functionally, almost to the rank of a phalanx. Here the variability is virtually *nil*; if it occur at all, it would be entirely abnormal; and the slightest normal difference in numerical composition, either in number of digits or of their phalanges, has a generic, if not a higher, value.

"The value of numerical composition of the pollex and primus as a morphological character, has been estimated by different anatomists at its two possible extremes—some considering it an insuperable objection to the antitropic homology of pollex with quintus, and others finding it little or no obstacle to such a view. Two considerations have had great weight with me, in reducing my estimate of its value so low, that it presents itself as no valid objection, when taken in connection with the strong evidence derived from other sources. In the first place, the question can only arise in respect to five-fingered mammals, a part, at least, of the digits of which have three phalanges each; and since here we have the maximum known number of digits, and the next to the maximum known number of phalanges (Cetacea alone having more) the susceptibility of variation in numerical composition is nearly at a maximum, according to the principles already laid down, and hence the value of numerical composition is nearly at a minimum so far as the manus is concerned.

"Secondly, it is certain that pollex and primus are telically correspondent (analogous), and no less so that the modification each has undergone in its composition is simply telical. Both have been strongly differentiated from the other digits in the same way, and for the same purpose. It is presumed that no anatomist questions the homology of the whole manus of a bird, a reptile and a mammal; yet the homology cannot be pushed to the individual osseous elements without recognition of vastly more difference in numerical composition than we are called upon to admit in the present case of pollex and quintus, and hence without tacit depreciation of the morphical import of mere number. The manus and the pes of a bird cannot be homologized with each other, according to any one of the current modes of comparison, without greater allowance still for telical modification in the matter of numerical composition. For myself, if I attempt to recognize any homology between the manus of a man, for example, and that of certain chelonians and of a cetacean, beyond a homology of the members in their aggregate, I must consider that a medius digit, for example, with three phalanges, corresponds to one with several more than three, and be-

lieve in telical suppression of a phalanx in one case, and a similar redundancy of phalanges in the other case. If I undertake to compare the manus of a bird with its pes, either antitropically or otherwise, I must admit with every single digit a difference in the numerical composition of its homologue. Until our morphological insight has penetrated far enough for the solution of such problems as these, it seems perfectly reasonable to maintain that the objections on the score of numerical composition that have been urged against the antitropic homology of pollex with quintus, and of minimus with primus, apply with manifold force to a majority of the homologies that anatomists consider determined."

### V. GENERAL PROBLEMS.

The radical difference of opinion respecting the morphical relations of membra which the historical sketch exhibits between such Syntropists as Owen, for instance, and such Antitropists as Wyman, is not to be accounted for by any assumption of difference in their knowledge of facts or their intellectual power, but rather, as it seems to me, by a recognition of the dissimilarity of the premises which they have admitted, and the methods of reasoning which they have followed: in the one case, the human body has been chiefly employed in making the comparison, and attention has been early diverted to the correspondence of the pollex with the primus in respect to size, numerical composition and relative position, when the manus is in its natural attitude of pronation, as with many quadrupeds. In the other case, more attention has been given to the telical antagonism of the ancon and genu with many animals, and to the relative position of the membra during the early stages of development.

In more general terms, the idea of Syntropy is based upon the obvious resemblance in respect to *size*, *numerical composition and natural attitude* of certain *highly specialized* parts of *peripheral* organs belonging to animals of *high zoological rank*, and in the *adult* condition; while the idea of Antitropy is based upon the antagonism of *relative position* of *proximal* and *less specialized* parts with animals *lower* in rank or at *earlier* stages of development.[1]

Now, without doubt, the question under discussion is primarily one of *structure* rather than of *function*; it is a *morphological* and not a *teleological* problem. Before it can be solved, it is evident that we must first ascertain which are correct of the two groups of premises above

[1] These ideas were advanced by me in part in 45, 21, and more distinctly in 57, (Props. 9 and 10).

mentioned; and our present inquiry is, therefore, what are the relative morphical *values* of different attributes, different organs, different systems, different species and stages of development?

To fully discuss this question would require many volumes, and I can only attempt at this time to present the conclusions to which I have been led by the material now at my command, and, perhaps, to indicate more definitely than has been done heretofore, the matters which demand especial investigation. For it is clear that some of us upon both sides have been arguing upon false or insufficient premises, and that we have taken some steps upon the "high priori road," which we shall have to retrace in order to reach the truth; still, I must claim that, as a rule, the Syntropists have, in spite of their numbers, fallen into the more serious errors, and have disagreed so decidedly among themselves, as to suggest upon that ground alone that their general view was incorrect; the Antitropists, on the contrary, have at least kept a great idea always before them, although they may have been too eager and confident, and been led astray by un founded fancies.

### Morphical Values of Characters.

Admitting then, as an abstract definition, that morphical value is the usefulness of any character in the determination of morphical relations, we have still to ascertain the *relative* morphical value of the various characters already mentioned. So far as I know, the phrase "morphological value" was first employed by Huxley, in 1858 (250, 381); "morphological *importance*" was used by Cleland in 1860 (215, 306), and the former phrase several times by Traquair, in 1865.[1]

In 1867, Wyman suggests that the osseous system is more reliable in the determination of intermembral homologies than the other systems (55,277), and a like comparison is made by Flower (66,239) in 1870; my own convictions of the need of some determination of morphical values, were reached independently, and were expressed in 1866 and 1867 (57 and 58); but, although I am convinced that an approximate estimate of the comparative value of the characters already mentioned might be reached by analogies, and by a careful study of the history of the question, yet there appears to be a more satisfactory method of accomplishing the same end; namely, by ascertaining the value which these characters have for the determina-

[1] On the Asymmetry of the Pleuronectidæ Trans. Linn. Soc., 1865.

tion of the other kind of morphical relations, plural homologies, upon which zoological classification is based; since, although few have spoken of the two halves of a single individual as if they were two distinct individuals and comparable in like manner, yet it is not probable that any one will object to such a view of the case, and such a method of comparison.

May we then conclude that morphical value is essentially equivalent to taxonomic or zoological or classificatory value, and that the only difference is that the former is used when two parts of the same individual are compared, while the latter is used when two different individuals are compared, with a view to ascertain their zoological relationship; if so, then morphical value is value in respect to single homologies, taxonomic value is value in respect to plural homologies; and since both are morphical relations, it seems probable that the same attributes, organs, systems, species and stages of development which have been found available in the one, should be given a like absolute and relative importance in the other class of morphical questions.

This conclusion seems warranted by the language of high authorities,[1] who either use morphological as if equivalent to taxonomic value, or imply that morphical relations, near and remote, are the true test of zoological affinity.

Assuming then provisionally, and until decided objection is raised by others, that morphical value and taxonomic value are correlative, we are now justified in considering the zoological criteria, which have been admitted, in order to ascertain the relative morphical value of the characters already mentioned; but here, unfortunately, we meet with a most unsatisfactory difference of opinion.

For instance, we find the same high authority making two incompatible generalizations, as follows: "The generative organs, being those which are most *remotely* related to the habits and food of the animal, I have always regarded as affording very clear indications of its true affinities; we are least likely in the modifications of these organs, to mistake a merely adaptive for an essential character." Owen (on the Dugong, Proc. Zool. Soc., vol. I, p. 40.) "Teeth are always most *intimately* related to the food and habits of the animal and are therefore important guides in the classification of animals." (63, 1, 361).

[1] Agassiz (201, *fere*), Huxley (251, 2 and 100), Gill, American Naturalist, vol. IV, Proc. Am. Ass. Adv. Soc., 1870, and Rolleston (294, XXII).

Dr. J. E. Gray "observed that in his opinion internal characters were of little use in Zoology; (Proc. Zool. Soc., Apr. 11, 1867, and Journ. of Anat. and Phys., 2, 371); while Parker admits the value of external characters, but says the mind will not rest in these outward things, and that the skeleton, nervous system, digestive, respiratory and vocal organs are very important.[1] Testimony to the zoological value of the skeleton is given by Agassiz,[2] but Owen speaks again as follows: "Guided by the seldom failing law that distinctive characters are most strongly developed in the peripheral portions of the body," etc.,[3] and further believes that the "form and disposition of the scales of the legs of birds have afforded distinctive characters to the zoologist" (63, 2, 232).

Further reference to the opinions of various authors, respecting the taxonomic value of different systems of organs is given by Rolleston (294, XXI, note), and the matter is briefly discussed by H. Allen[4].

It is quite probable that in practice all the above authors have been more definite than their language would imply, and that they have more or less perfectly discriminated between the value of an organ for one kind of group, and that which it might have for another; this is done by Wyman[5] when he says that the "teeth of mammals afford the surest indication of zoological affinities," because he means that for the determination of groups *within the class* the teeth have a high morphical value. Flower questions this fact,[6] but admits the principle, as had Turner before him,[7] by attaching morphical value to characters of the base of the skull within the order, Carnivora.

Günther likewise discriminates within the order, when he says,[8] "under these circumstances, I still feel satisfied to distribute the fishes on the basis of Müller's ordinal arrangement into minor natural groups, whether called families, groups or genera; and in my opinion, there is no character equal in importance to that of the structure and position of the fins; as they are in immediate connection with

[1] Trans. Zool. Soc., v. 149, 1862.
[2] Anat. des Salmones, p. 1.
[3] Memoir on Dinornis, p. 78.
[4] Outlines of Comp. Anat.. and Med. Zool. p. 13, 1869.
[5] Lectures on Comp. Physiology, 1849, p. 24.
[6] Proc. Zool. Soc., 1849, p. 5.
[7] Turner, H. N., P. Z. S. 1848.
[8] Catal. of Acanth. Fishes. Preface. 1861.

the entire habit of fishes, and with their mode of life, they best indicate their natural affinities, and indeed prove to be the most constant and general characters."

As to generic criteria, Müller and Henle enumerate[1] the characters found by them most useful among selachians; and Parker is explicit respecting the unimportance of certain characters, for the determination of groups more comprehensive than genera.[2]

Specific characters of the Pycnogonidæ are enumerated by H. D. S. Goodsir,[3] and those of the tortoises by Owen (62, 1, 162.)

Finally, a great part of Agassiz's later works (200 and 201), is devoted to the effort to show not only that groups really exist in nature, but that they are based upon distinct "categories of structure." I quote the following also from my notes of his lectures on Selachians.[4] "Zoologists take very different criteria or different parts as foundation for the same kind of group, or the same criteria for different kinds of groups, so that their results are very diverse. We must have some means of determining the *value of characters.*"

Accepting provisionally Agassiz's abstract enunciation of these criteria and their subordination as to value, as summed up on page 261 of 201, and likewise considering the only direct application of these principles to a single group, the Testudinata and its subdivisions (200, 1, Part II), I have endeavored to translate the zoological criteria into anatomical language, and in this way to at least indicate the means by which we may sometime be able to determine the exact morphical value of any anatomical character. The conclusions which I reached are given in the diagram (page 179), and afterward briefly explained; but I must here admit that I feel sure of being right upon only the following points:

1. That both *plan of structure* and *form* are displayed upon a vertico-lateral section of an animal.[5]

[1] Ann. and Mag. of Nat. Hist., 1844, pp. 1 and 4.

[2] Proc. Zool. Soc., 1863, p. 572.

[3] Ann. of Nat. Hist., July, 1844, p. 1.

[4] Given at the Museum of Comp. Zool., 1867 - 1868.

[5] As between Vertebrata and Radiata, or between either of these and the Mollusca, and Articulata this is clear enough; but since the relative positions of digestive, nervous and circulatory systems seem nearly identical in the two latter branches, the respiratory and perhaps some other systems must be included in our representation of a vertico-lateral section. See Huxley's diagrams, 151, fig. 30. As to the view that Vertebrata and Mollusca may find connecting links in Amphioxus and the ascidians (references to which are given in 336). I have not yet seen any comparison of the vertico-lateral sections of these animals, or any statement that they are identical.

2. That plan of structure depends upon the relative normal position of important organs; while form depends upon the relative size of these and other organs. If, then, it is true that the *branch* is determined by the plan of structure, and the family by the form, it follows that relative size is of less morphical value than relative normal position; it seems probable, too, that the natural attitude of organs must be similar within the same family, since the membra of a family have not only the same form, but the same mode of locomotion; if this is true, then this character also is of less morphical value than normal position.

3. I am also convinced that segmentation, or numerical composition, is of less morphical value than either of the characters above named; but this has been already considered.

In support of the general conclusion which is expressed by the diagram (page 179), that internal characters are more valuable in the determination of the more comprehensive groups, while external characters are more valuable for the determination of lesser groups, which would ascribe to the former more, and to the latter less, morphical value, I can bring little direct evidence; but the following passage from an eminent conchologist shows that the idea is not confined to myself; and I am inclined to believe that it must have been in practice, at least, recognized to some extent by all who have sought to reach a natural classification.

"In all attempts to characterize the groups of animals, we find that in advancing from the smaller to the larger combinations, many of the most obvious external features become of less avail, and we are compelled to seek for more constant and comprehensive signs in the phases of embryonic development, and the condition of the circulatory, respiratory, and nervous systems."[1]

The above is in part confirmed by Agassiz's view that the genera of turtles are based upon the voluntary organs of nutrition, the jaws and other muscles (200, 1, 422), and by Owen's view that the primary subdivisions of the mammalia are characterized by the condition of the brain (63, 2, 270[2]), and further by the general acknowledgement that osteological characters alone are often insufficient for the dis-

[1] Woodward; Recent and Fossil Shells., p. 56.

[2] Flower (Phil. Trans. 1865, p. 647), remarks of the brains of monotremes and marsupials as contrasted with those of other Mammalia. "The appearance of either a transverse or longitudinal section would leave no doubt as to which group the brain belonged.

crimination of species within the same genus; although Owen once held a different opinion. (Trans. Zool. Soc., vol. II., p. 379, 1838).

But how can we reconcile the above generalization with the statement of Dr. J. E. Gray,[1] that with the Balænidæ and Balænopteridæ, "every bone of each genus is peculiar, though not always easy to describe; likewise, almost every bone of each *species*, especially the ribs and phalanges, the skull, tympanic bones, scapula, and cervical vertebræ"? Is it not probable that there *are* not only specific but individual differences between two individuals in each and every part of the body, and in each and every possible attribute of these parts; but that these differences are more *obvious* in some parts than in others, so that certain parts and attributes are more *available* than others? and such a view is by no means incompatible with the result of our experience, and with the analysis of other matters which lead us to believe that for the determination of more important and comprehensive questions, we must look to the central and essential parts, while minor questions may be decided by observation of peripheral and less vital organs. For instance, a single vertebra would enable us to say whether its owner were a reptile, a bird, or a mammal; but it would far less distinctly exhibit the particular genus or species to which it belonged; on the other hand, the manus of the whales and of the Sirenia resemble each other, and even that of the penguin might not be at once recognizable as that of a different class; but within the same order or family, the genus would be at once apparent from the special proportions of the parts.

According to Gray,[2] the long spine which has been described as *Myriosteon Higginsii*, was thought by some to be the tail of a ray, but is probably part of a starfish; certain pointed fossils are thought by Pander to be teeth of selachians, by Owen to be from the borders of the suckers of cuttlefish; the "ichyodorulites" have been regarded as spines of Crustacea by some authors, but as selachian spines by Agassiz[3]; from which the latter concludes that these parts are at any rate not available as either branch, class, ordinal, or perhaps family characters, but rather as generic; the "bird-tracks" in the Red Sandstone of the Connecticut Valley, did not at once indicate whether the feet which made them belonged to birds or to reptiles;

[1] Proc. Zool. Soc., 1864, p. 228.
[2] Proc. Zool. Soc., 1864, p. 163.
[3] Lectures on Selachians, Dec. 1867; (unpublished).

now all the above examples are peripheral parts, and the like questions never would have arisen with such a part as a vertebra.

Putnam [Am. Nat., Jan. 1872, p. 26, note], mentions the slight taxonomic value of air-bladder, head-scales, barbels, ventral fins and eyes, and Agassiz once figured fossil Crustaceans [*Eurypterus remipes* and *Pterygotus*], as fishes on account of their external aspect.[1]

Packard[2] has recognized the unreliability of characters drawn from peripheral and inconstant organs, like the mouth parts and wings; and Owen himself seems to recognize the principle, "Judge not according to appearances," in the following paragraph: "The prominent appearances which first catch the eye are deceptive; and the less obtrusive phenomena which require searching out, more frequently, when their full signification is reasoned upon, guide us to the right comprehension of the whole."[3]

From the unpublished lectures on Selachians I again quote Agassiz: "The Chimeræ are generally separated from the other Selachians on account of a single branchial fissure; but as this is a *variable* character, it should not set aside more *internal* characters."

A zoological illustration of our proposition is given in the great variety and discrepancy of the definitions of the vertebrate type; so long as investigators regarded especially some one group with which they were more familiar, and so long as they included in their definition of an abstract idea, the special structures which characterized those minor groups (see Agassiz, 201, 213), so long they disagreed among themselves, and failed to follow Nature; this is seen in the difficulty which others have found in accepting Owen's archetype skeleton as correct; for it is essentially a piscine skeleton, and although the great anatomist holds that fishes depart least from the vertebrate archetype (63, 1, 102), such a generalization involves reasoning in a circle, and has been adopted by few (as Maclise, 23, 674–676).

The Amphioxus is, without doubt, the simplest known vertebrate; but it cannot be regarded as *the* material manifestation of the vertebrate idea, since its structure presents positive characters by which

[1] Microscopic section of the tooth of Ceratodus has convinced Mr. Bicknell that it is "unsafe to found genera or even species upon the microscopical structure of a single tooth or bone, although it has proved correct in many cases." Proc. Bost. Soc. Nat. Hist., April 19th, 1871.

[2] Guide to the Study of Insects, p. 14.

[3] Palæontology, p. 357.

it is not merely an exception to the generalizations applicable to all other fishes, but which seem to constitute it a distinct class, coëqual with the Myzonts, Selachians, Ganoids, and Teleosts; still there can be no question that this simply organized vertebrate, presenting the fewest organs, and the simplest functions, really does come the nearest to being the realization of the ideal plan of structure of the branch. Now the Amphioxus may be said to be the zoological counterpart of the embryonic state of the higher vertebrates, and to hold within the branch a central position, surrounded by the more specialized organisms, as the central and constant organs of a single individual are encompassed by peripheral and variable ones.

A still better illustration will be furnished by the very question now under consideration, in case it is decided in favor of antitropy; a glance at the manus and pes of most animals indicates a general correspondence between them; but they alone would furnish no sure guide to the principle upon which they are to be compared in detail; at any rate, even if we are not right now, the total disagreement for a century is sufficient evidence of our proposition, and of the need of appealing to more central and reliable parts of the membra, and even to the trunk itself.

From the foregoing considerations, there arises the suggestion that the morphical value of a part of an animal, is in an inverse ratio to its telical importance; that *reliability* is inversely to *variability*; and, that hence, in determining morphical relations, we should regard primarily, those parts which are constant in position and function, and secondarily, those which are variable and inconstant, whether zoologically, physiologically or teratically.

The variability of the two extremes of the vertebral column is remarked by Owen, (63, 1, 94,) and Bell[1] connects peripheral variability with diversity of function in language the more suggestive, as coming from so "untranscendental" an anatomist.

It is generally admitted that multiple organs, whether animal or vegetal, are liable to variation, and many authors have remarked the variability of the membra; Owen refers to it in many places[2]; T. Rymer Jones[3] suggestively associates peripheral position with variability in number and appearance; and Pouchet[4] goes so far as to

[1] On the Hand; close of chap. 2.
[2] Trans. Zool. Soc., 1835, p. 353; 20, 333; 20, 269; 63, 2, 254.
[3] Cycl. of Anat. and Phys., 3, 841 and 843.
[4] Plurality of races, p. 47.

acknowledge that the "law which causes the modifications of organisms, becomes more and more decided and clear *from the centre to the periphery.*" I may here say that the convictions expressed in 58, (Props. 9 and 10) were formed independently of the authors above quoted.

The results of a tabulation of cases of sexdigitism and hexadactylism,[1] (as given in 313), have been confirmed by the addition of cases, gathered up to Jan. 1, 1870; at that date, of 242 individuals affected, 152 were males and 90 females; and of the membra, 312 were armi and only 155 skelea; this not only shows the extreme frequency of this malformation of peripheral parts belonging to the highest vertebrate animal, but also indicates that in this respect, the skelos is more constant and reliable than the armus, as it is also the membrum less often and less extensively modified for special purposes throughout the vertebrate type (313, 10); but in respect to the vascular system, particularly, Meckel believes the reverse is the case, (6, English edition, 2, 176); and upon this question more remains to be done.

Another very important question is as yet undecided; is the homology of a muscle to be determined mainly by its place of *origin*, or its point of *insertion?* The latter is the opinion of Mivart (46, 398) Rolleston (61, 620), (with some exceptions), and Humphrey (64, 321). Coues states that the insertion is less frequently changed than the origin (70, 223), and I know of no author who has taken the opposite view[2]; I am not now prepared to do so, and would suggest that we ought first to discriminate between the "sliding up or down the *same* bone" referred to by Coues (70, 223), and the lateral transfer from one bone to another, as of the tendon of insertion of the *biceps brachialis* (Coues, 70, 299); the former transfer would generally be for the purpose of securing greater length of fibre, and extent of motion, and would also occur more frequently with the origin; but the latter would affect the essential function of the muscle, and would perhaps warrant us in regarding a muscle so affected as wholly distinct.

[1] Do cases ever occur of extra digits, or dactyls upon both borders of the manus or pes?

[2] Since this was written, the graduation thesis of W. S. Barnard, "On the Membral Myology of the Orang" has been prepared in my laboratory, and the facts and ideas therein presented have nearly convinced me that the homology of muscles depends far more upon their origins than upon their insertion: the paper has been offered for publication to the Boston Society of Natural History.

## Morphical Integers.

This suggests a further and very important enquiry. What is a morphical integer, whether in the muscular or osseous system, or among the digits and dactyls? The phrase "morphological integer" is first used by Coues (70, 222), but the general problem has been considered by Owen and others, with especial reference to the bones. The question of Spencer (299, 2, 526), "How are centres of ossification which have a homological meaning to be distinguished from those which have not?" is not answered satisfactorily by Owen's reference to a "knowledge of the archetype skeleton" (63, 1, XXIV), since the knowledge itself depends upon the prior determination of the question. I do not feel ready to discuss the question, but would call attention to its great importance, and to the need of such investigations as those of Parker; this author (292, 4) thinks that "true and safe landmarks" for the recognition of "morphological territories," may be found in segmentation both by fission of primary cartilage, and by the appearance of two or more separate centres of ossification within the same undivided tract"; but it is evident that much more remains to be done, not only for the bones, but for the muscles, in order to ascertain the morphical integers and equivalents in the osseous and muscular and other systems.

## What Constitutes a Digit or a Dactyl?

There do not appear to have arisen as yet any serious discrepancies between the statements of different authors respecting the number of digits or dactyls which may exist in a given animal; but since no one, so far as I know, has given a general rule by which to determine the above question, and it is probable that at some time direct contradictions will appear in different works [1], it is worth our while to inquire into the elements which might form the basis of such a rule.

Among the mammalia, the vast majority of those digits and dactyls about which no question can arise, consist of three phalanges, are visible to the eye as subdivisions of the distal extremity of the member, and perform some obvious function in the economy of the animal; the ordinary mammalian digit or dactyl is then *functional*, *visible*, and *trimerous*. But to this definition are many exceptions.

[1] Leading perhaps to as unfortunate complications as the conflicting accounts of the *hippocampus minor* and the *corpus callosum*.

First: in respect to the *number of phalanges*, which may be increased to 14 (index of Globiocephalus) or, more commonly, reduced to 2, (as with all the digits of Pteropidæ and the pollices and primi of most species), or to 1 (as with the primus of Simia); but all these dimerous or monomerous digits and dactyls are visible and functional, and numerical composition alone is evidently insufficient to determine their right to be included with the rest. But there may be no phalanges whatever, and merely the metacarpal or metatarsal bone; and the question may arise as to the propriety of including that in the enumeration.

Second: in respect to its external visibility. The pollex of Hyæna (63, 2, 306), has a single minute phalanx, supported by an equally minute metacarpal; the *Hyrax capensis* offers a similar structure; these digits are monomerous, concealed, and apparently functionless, and would not be enumerated in a new species by one who confined himself to the external characters which are believed by many to serve for generic and specific distinctions; yet, undoubtedly, an anatomical description of the species would mention the existence of five digits in both these animals, in contradistinction to a new Tapirus, which presents only a rudimentary pollical metacarpal. Again, although the pollices might be concealed from the sight, they might be felt under the skin, and another and distinct element must be taken into account in framing our definition.

Third: a digit or dactyle may be trimerous and visible, and yet, to all appearance, functionless or *atelic*; such are the "dew-claws" of many Artiodactyla, and the slender index and annularis of Hipparion (63, 2, 309, and 63, 3, 825); they are supposed to prevent sinking into soft soil, but there seems no reason why the Camelidæ should be wholly destitute of these organs, if this is their use with the typical Ruminants; such are also the pollices of the Canidæ and Felidæ which have little if any power of motion.

The above are instances of what are generally called "rudimentary organs," to which so much attention has lately been directed, and respecting which such contradictory opinions are entertained; this is not the place for a discussion of the general subject, but the above remarks may indicate the special questions as to the definition of digits and dactyls.

### Histological Composition.

The morphical value of this attribute of organs is variously estimated by different authors; Agassiz, in the second passage already

quoted, evidently thinks it is not of class value in the determination of homologies among radiates; Parker, 292, 3, associates "histology" and "function" in such a way as to indicate that he regards their morphical value as less than that of relative position. But it does not appear that due attention has been given to the problem suggested by the following considerations:

It is certain that a tendon may ossify, as in the skelea of fowls and the so-called "marsupial bones," so that what was at one time fibrous becomes osseous in structure; the same, however, holds true of the membrane bones of the skull, and of course, no one questions the homology of a bone with its own pre-existing cartilage, or with that of another individual or part of the same indiviudal; and upon this ground alone no objection arises to Owen's view of the meke-syntropic homology of the marsupial bones[1] (63, 2, 356); so, too, the capsule of the eye-ball is generally admitted to be homologous throughout the vertebrate branch, although it is fibrous in man, gristly in the turtle, and bony in the tunny (Thynnus) (63, 1, 26). But is it possible for a muscle to be the true homologue of a ligament? as Duvernoy thinks of the human *subclavius* and the costo-coracoid ligament of the gorilla[2]; and still more, can muscle correspond to bone? as is assumed by Humphrey and Huxley of the clavicle and Pouparts' ligament (72, 77 and 78, 37). Coues alludes to a theory (apparently a notion of his own) that certain omozonic muscles may be antitropically represented in pelvico-sacral ligaments. It might be urged that since in a typical muscular organ, muscle and tendon are continuous parts, and since the belly of a given muscle may be of very different lengths in different species, they are in one sense homologous structures, but evidently there should be a better understanding among homologists respecting the morphical value of histological composition.[3]

## Mode of Development.

Respecting the morphical value of this attribute of organs and animals, the most widely diverse opinions have been held. Owen has constantly urged its slight importance in comparison with adult struc-

[1] As to the rudimentary fibro-cartilages of Thylacinus, see Owen, Proc. Zool. Soc., 1843, p. 148.

[2] Archives du Museum, Tome VIII; referred to in 88, 867.

[3] Goodsir alludes to this question (297, 397), when he says, "*Tissue is subordinate to form*," and Huxley mentions without comment, the extraordinary fact that the outer serous stratum, or *epiblast*, of the beginning embryo, gives rise to the two anatomical and physiological antipodes, epidermis and cerebrospinal nervous centres (78, 10).

ture and relative position, and I quote a few passages: "There exists, doubtless, a close general resemblance in the mode of development of homologous parts; but this is subject to modification, like the forms, proportions, functions, and very substance of such parts, without their essential homological relationships being thereby obliterated. These relationships are mainly, if not wholly, determined by the relative position and connection of the parts, and may exist independently of form, proportion, substance, function, and similarity of development. But the connections must be sought for at every period of development, and the changes of relative position, if any, during growth, must be compared with the connections which the part presents in the classes where vegetative repetition is greatest and adaptive modification least" (20, 174). "So far is embryology from being a criterion of homology" (63, 1, XXVI). "Embryology affords no criterion between ossific centres that have a homological, and those that have a teleological significance" (63, 1, XXV). "No part is, however, absolutely autogenous throughout the vertebrate series, and some parts usually exogenous are autogenous in a few instances" (63, 1, 27). "The developmental phenomena of the head neither supersede nor can supply the better evidences of homology afforded by relative position and connections, any more than do those of the foot; . . . it is neither here nor elsewhere the criterion of homology" (63, 2, 311). Cleland says, "Morphologically, it is of little importance whether cranial bones are developed *in* the primordial cartilage of the skull or *around* it" (215, 305).

The general importance of embryology in the determination of homologies has been urged by Goodsir and Huxley, and in 251 the latter has well indicated the necessity of deciding the general question before attempting to solve minor problems respecting the correspondence of the skull and the vertebral column. Agassiz has constantly presented the taxonomic value of embryology not only throughout his later works, but in the lectures on Comparative Embryology, Boston, 1849; and upon the ground of a difference of development, he in great measure bases his opinion that the Batrachians form a class distinct from the scaly reptiles; but in discussing this, Dana asks[1] "whether, in the determination of *classes* it is not the more correct method to take note primarily of species in their finished or adult state; and whether adults do not express the true nature and idea of species, or the objects to be classified, rather than the special

[1] Am. Journ. of Sci., Mar. 1864, p. 184.

series of changes through which the adult characteristics are reached."

On the other hand, Owen based his own nomenclature of the mammalian molar and premolar teeth upon the facts of development; but Flower (227), and Moseley and Lankester (282) have pointed out defects in this system, and the latter even hold that "the existence of any homology at all between upper and lower jaw teeth must be denied; it could only have a theoretical existence in connection with that view of the structure of the vertebrate skull, which placed the upper and lower jaws as homologous parts of a vertebra" (282, 272).

Now all this has no apparent reference to intermembral homologies, but it must nevertheless be considered before any conclusion can be reached satisfactory to all; are, or are we not, justified in comparing the membra together in that condition in respect to both position and structure, which they present when first forming in the embryo? if not, then the utter disagreement between Syntropists and Antitropists will forever remain; but if we are, then the former must simply eliminate from their train of argument, all such criteria as numerical composition, size, shape and function; and both must wholly disregard the telical parallelism or antagonism which exists between the corresponding parts of the membra of some animals, and must endeavor to ascertain first the general laws of organization according to which the trunk is formed.[1]

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## October 4, 1871.

The President in the chair. Thirty-seven persons present.

Mr. Alonzo Meserve of Neponset was elected a Resident Member.

Prof. Louis Agassiz made the following verbal communication: —

Great doubt has always existed among naturalists as to the method of copulation among Selachians, and there is no definite information on this point. In speaking of the subject it has been assumed that the appendages of the male were used in clasping the female during the act, but no facts are given in regard to the manner of their use.

[1] To be concluded.

As far as anatomical features are concerned, we have information no where more full than in the fourth volume of Cuvier's Lectures on Comparative Anatomy. In reviewing the accounts given by various observers, we find that Aristotle really knew more about the process than all other zoologists since his time. He says the cartilaginous fishes in copulation "hang together after the fashion of dogs, 'ὥσπερ κυνας,' the long-tailed ones mounting the others, unless the latter have a thick tail preventing this, when they come together belly to belly." Before my late illness I had the good fortune to be able to observe and study the subject among the sharks and skates, with results which satisfactorily settle this question; no opportunity to investigate the Trygons has yet occurred to me. One ray of each posterior fin is capable of erection and rotation, and is covered with erectile tissue, far too delicate to allow it to be used as a clasper around a body covered with sharp, rough spines. In the act these two organs are rotated inward and forward, bringing the furrows on their inner surface into parallel contact, and in apposition with the testes. Being then introduced into the body of the female, their extremities diverge in the two oviducts, and the *glans* being uncovered exposes a sharp cutting instrument, which would injure the organs of the female if she resisted; the male has her, therefore, in complete subjection, and has been observed to strike and wound her with this spine. What was formerly supposed to be the penis is too small, and of insufficient length to accomplish fecundation. The penis consists of the two long flexible finger-like fins, furnished with two projectile spinous appendages, as in vipers. (In Chimæra the surfaces of the organs are also spinous, as in snakes.) The two spines found in cartilaginous fishes are homologous with the *os penis* of mammals. In man this bony part has disappeared, and we have only the soft spongy portions of the organ remaining; the quivering of the legs during connection seems the echo, as it were, of the sensitiveness of the flexible posterior limbs of the skates.

The fins of the male skate resemble those of the female, having only in addition the sexual organ. We are led here to consider the connection between posterior limbs and sexual organs. In the snakes we find the latter organ, but no limbs. The examination of the homologies of the penis shows these various forms, the long erectile, the smaller pointed, and the mere tubercle. We may therefore conclude that the more lascivious animals have gradually developed these organs, or, as seems to me far preferable, that this

difference of form is the device of the same great creative thought, as illustrated in an infinite variety of methods in all objects of creation.

Dr. C. T. Jackson read the following letter from Mr. J. B. Meader, on the mineral resources of Utah, announcing the discovery of a Bismuth mine in that territory.

*Salt Lake City, Sept.* 3, 1871.

*My Dear Friend:*

I have for some time been on the point of writing to you and giving you a little outline of the mineral resources of this Territory and finally I have brought myself up to the point.

Utah is pretty well supplied with valuable minerals, but as yet the principal developments, as in all other new countries, have been made upon those mines which produce ores more or less rich in silver or gold.

Gold is not very plentiful here; however in "Bingham" Cañon some twenty-five miles southwest of the city they are working some "placer diggings" which produce gold in paying quantities, the total yield of this district in gold being upwards of $150,000.

Also at "Deep Creek" some hundred and twenty miles west of here they find some gold in veins of quartz; and the quartz carries from 5 to 15 ounces copper; this district being rather out of the way and so far removed from railroad facilities, is not in mnch favor, so as yet nothing of any note is being done there.

These two sections are the only ones in which as yet gold appears to be found.

Silver is more abundant; its most ordinary forms or rather the class of ores which produce the most of it is the lead ores. These ores are very abundant, and there are more than a dozen districts within a radius of eighty miles from the city in which they are found.

The most remarkable mine yet opened is the "Emma," a mine situated in Little Cottonwood cañon twenty miles southeast from here. The mine has produced several thousands of tons of ore, and is said yet to contain large quantities opened up ready for extraction. The ore is of a very singular character, it would perhaps be more appropriate to say that it has no character at all, for it is a strangely mixed up deposit. The vein produces galena, fine grained; black antimonial galena, coppery carbonate of lead, decomposed antimonial

lead and silver, and a black ore quite soft, fine grained, containing arsenic, antimony, lead, sulphur and silver.

The above varieties of ores occur in places where the vein is hard and compact, but a large portion of them are decomposed and occur in the vein apparently mixed up with vein stuff; where this occurs the vein is soft and requires no blasting, and when the ores are taken out they resemble coarse sand slightly stained with oxide of iron.

The ore that has been shipped from this mine will average about 35 per cent. of lead and contains from 100 to 190 ounces silver to 2000 lbs; perhaps 150 ounces would not be far from the actual average.

I have assayed specimens of galena from this mine which contained 450 ounces silver to the ton, and others of the antimonial galena carrying as high as 520 ounces. One peculiarity of the ores from this mine is, that the percentage of silver in the ores is constantly varying, and bears no ratio whatever to the amount of lead contained — for instance, one piece of galena contained 94 ounces silver to the ton, while another specimen identical as to looks and the per centage of lead, contains 150 ounces. But as I did not intend to particularize, I must pass on.

There are two or three districts where silver abounds in ores free from lead. The principal district producing what are classed here as milling ores is East Cañon, situated some fifty-three miles southwest from the city. The ores found in "this district" are quite rich in silver. The silver exists in the form of horn silver, chloro-bromide, carbonate of silver and decomposed antimonial silver; as yet no sulphide of silver has been found that I am aware of. I have some very fine specimens of horn silver from this district, also some from "Tintic" some seventy-five miles south-southwest from here. I have found specimens carrying as high as 60 ounces of silver. Copper is not very abundant; however, there are several localities in which it occurs in paying quantities. At "Tintic" they have a very large deposit, the ores are principally carbonates, and some very fine specimens of azurite are found. I am inclined to think that at a depth the ores will change, but what they will be below water level is hard to tell. There is one species of ore from this locality which resembles stibnite somewhat in looks and in the form of crystalization but it consists of arsenious acid and copper; as yet I have not had an opportunity to fully analyze it. There are some ores also in the "Cotton-

wood Cañons" cary-copper pyrites and "horseflesh" copper ores. Iron is found in abundance but as yet is not made available.

Now as to the financial success of the mines I have but a few words to say. Of course all mines which produce ores rich enough in silver to leave a profit after shipping to either of the points where smelting is carried on, say San Francisco in the West, Omaha, Chicago, Newark and New York in the East (I speak more particularly of lead and silver ores), are profitable, and are making their owners rich. But for those mines which produce ores, carrying only say from 15 to 25 ounces silver, the future is rather doubtful.

Smelting has been undertaken and carried on by people wholly ignorant of the business, and as yet has proved a failure; and I am decidedly of the opinion that until it is carried on by a company with a very large capital, and under the direct charge of some one fully capable to conduct such enterprises, it will continue to be a failure. We lack many things here to enable us to make an immediate success of smelting, yet should works, as I have stated above, be erected at some central point where all the classes and varieties of ores would become available, I think they would prove successful.

There are several ordinary German blast furnaces under operation at various points in the territory, and they are producing more or less lead; but I fear should one make careful examination of their work, assaying the ores before they go into the furnace, and keep accurate account of the quantity used, and then assay the pig lead and weigh up the quantity produced, they would find that from 25 to 30 per cent. of the lead was lost, and from 20 to 40 per cent. of the silver unaccounted for. Some of the lead produced here contains as high as 15 per cent. of antimony.

One specimen of lead which was brought to me to determine the percentage of antimony it contained, yielded 15 ounces of sulphide of lead, showing conclusively that it had been *melted*, but that they failed to get a thorough reaction, and the sulphur had not been eliminated. Yet the future should be prosperous for this place, and another year I look for great changes.

But I am drawing this letter into too voluminous proportions, and yet I have to speak of the subject which I considered the principal one of interest when I commenced to write.

Last fall a person came into my office with a sample of ore to be assayed for lead and silver, mistaking some black shining crystals for galena. My assistant mixed up an assay in the usual way for a

crucible assay for lead, and obtained a brittle button which he could not account for; he called my attention to it, and I found it to be "*bismuth*."

The result of this examination was not arrived at until some time after the man who brought the ore in had left town, and it was not until December that I found him again, at which time I learned where he got the ore, and made arrangements for an interest in the mine. My father immediately proceeded to the place (which is about two hundred and fifteen miles south from here, in "Beaver County," seven miles from the town of Beaver), and made an examination of the property. He found a well defined vein cropping out boldly and strongly for three thousand feet in length. On one side of the vein the rock consists of granite, while at the other side it is carbonate of lime. The vein is about seven feet wide, and as far as developed, down to a depth of fifty feet, is very regular. The gangue consists of quartz, hornblende, some granite, and is interspersed with garnets.

The bismuth exists as sulphide (bismuthite), or I should say (bismuthinite) and bismuth ochre, and as yet there is no other metal mixed with it; the gangue, however, contains some iron pyrites. From all appearances it is the largest deposit of bismuth ever discovered; we are going to work it, and it is our intention to crush and concentrate the ore on the ground for the present, as we can bring it up to a product containing easily 40 per cent. of bismuth.

Some specimens of the ore I have found to contain as high as 87 per cent., just as they came out of the mine. I look upon it as one of the most valuable discoveries yet made in the Territory.

It is my intention, as soon as father returns from the mine, to make you up a collection of specimens and forward to you, at which time I may have more to say on the subject.

Yours very truly,

J. B. MEADER.

P. S. I might mention that, as a general thing, the silver ores here are entirely free from gold, but there are one or two exceptions, The "Flagstaff" mine, situated not far from the "Emma," in Little Cottonwood Cañon, produces an ore which will, on the average, contain 58 per cent. of lead, 60 ounces silver, and $\frac{75}{100}$ of an ounce of gold, while all the other mines in the immediate vicinity do not con-

tain a trace of gold. From the fact of gold existing in this isolated case, and the large proportion of oxide of iron contained in the vein matter of the mine, I shall look for some discoveries of gold-bearing quartz veins near that locality.

Dr. C. F. Winslow is a resident of our city, and has become interested in the bismuth mine with us; he was here this evening and wishes to be remembered, and sends his kind regards.

J. B. M.

Mr. Moses Woolson, recently from Salt Lake City, and present by invitation, confirmed this account, and said he had seen fine specimens of bismuth and sal ammoniac from Cottonwood Cañon, where it was said a mountain of the latter substance existed. He had seen finer specimens of azurite in that vicinity than he had ever before observed in America.

In reply to a question of Dr. G. F. Waters, Dr. Jackson said there was rich tin ore in Winslow, Me., but the mine being in the hands of poor and ignorant parties was not worked.

Prof. G. F. H. Markoe exhibited some stereoscopic views of the interior of the "Mammoth Cave," Kentucky, and described its most interesting features.

Prof. Shaler also spoke of this and other similar caves. He had no doubt that in the region of the Kentucky cave many thousand miles of subterranean passages exist, which have been formed by water percolating through the limestone.

The thanks of the Society were voted to Mr. J. G. Swan, of Port Townsend, Washington Territory, and to Mr. Chas. Horton, of Boston, for gifts to the Museum.

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Section of Microscopy. October 11, 1871.

Mr. Edwin Bicknell in the chair. Ten members present.

Mr. Greenleaf stated, in reference to the circulation in Amœbæ, that he had seen the central forward current, but

never the two return side currents so often described. He considered these merely optical delusions.

Mr. Stodder said he had lately tried collecting germs from the atmosphere. This last summer he had in his experiments used a glass vessel filled with ice, on which the moisture of the air condensed outside. In this manner nothing not in the air was obtained. In his examinations he had followed the methods given by Dr. Maddox in the February number of the Monthly Microscopical Journal for 1871.

He, at first, placed the germs so obtained in molasses, but subsequent examination showed that this contained abundant apparent germs of its own. He next took pure crystals of sugar dissolved in the water collected, and placed on a slide. To keep the moisture present, he had used the cell described by Dr. Maddox.

His first collection made August 11, developed in a few weeks mycelium and spores of fungi in great abundance.

Other collections of the same date have as yet shown but few signs of life. He had found in these experiments that no animal life was developed.

Mr. Greenleaf showed a simple growing slide. A small hole was drilled in the centre of a common slide, which was placed on the edge of a shallow tray containing water, with the hole below the water level; placing a thin glass cover over the hole, we have a self supplying water cell.

Mr. Stodder exhibited some photographs by Dr. Woodward, of *Amphipleura pellucida*, *Stauroneis Baleyii* and *S. Stodderii.*

Mr. Bicknell spoke of the difficulty in using the microscope vertically, a position which is often necessary, in such work as observing living animals in fluid, or in dissecting. He had obviated this difficulty by using an ordinary Nachêt camera lucida, by placing the camera lucida on the eye piece in the usual manner, and looking into the underside of the

camera lucida, at an angle of 30° from horizontal, a perfect view of objects on the stage of the microscope is obtained. The position is thus very easy, and entirely free from the usual constraint attending the use of the microscope when in a vertical position.

Mr. Bicknell also exhibited an achromatic condenser made in the form of an eye piece, and remarked: —

Dr. Beale in "How to work with the Microscope," has recommended the use of the "Kellner eyepiece" as a condenser, and says "by stopping off the greater part of the light passing through the condenser by placing over the upper lens a thin plate with a very small central hole, great advantage results in working with high powers." In the condenser shown by Mr. Bicknell, the amount and direction of the light is controlled by a revolving diaphragm placed between the lenses, where the diaphragm is usually placed in an eyepiece; there are three holes of different sizes for direct light, one hole with a central stop for dark field illumination, which gives an admirable effect with objectives under 30° ang. ap., and there are two oval openings and an oblong opening, especially for use with binocular instruments. The oval openings are opposite each other and are in use at the same time, giving two oblique pencils of light converging to a point.

This condenser was used with various objectives from a 1½ in. to a 1-50th of an inch, giving ample light for the latter with the highest eyepieces.

With this condenser and a 1-5 of only 100° angular aperture, I had seen the same test object that had required a 1-10 or 1-12, of 150°, when used without it.

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October 18, 1871.

Vice President Dr. Chas. T. Jackson in the chair. Fifty-five members present.

Prof. Louis Agassiz delivered the following eulogy on Dr. J. E. Holbrook: —

The death of Dr. Holbrook has been deeply felt by a very large circle of friends, and by those who are acquainted with the history of science during the last fifty years. But highly as he was appreciated by all to whom he was personally known, and by his scientific peers and colleagues, America does not know what she has lost in him, nor what she owed to him. A man of singularly modest nature, eluding rather than courting notice, he nevertheless first compelled European recognition of American science by the accuracy and originality of his investigations. I well remember the impression made in Europe more than five and thirty years ago, by his work on the North American reptiles. Before then, the supercilious English question, so effectually answered since, "Who reads an American book?" might have been repeated in another form, "Who ever saw an American scientific work?" But Holbrook's elaborate history of American Herpetology was far above any previous work on the same subject. In that branch of investigation Europe had at that time nothing which could compare with it.

Born near the close of the last century, in '96, Dr. Holbrook entered upon his career as a student at a moment of unusual activity in scientific research in Europe. Although his birth occurred at Beaufort, S. Carolina, he received his early education at the North. His father, himself a New England man, brought him, when only a few months' old, to Wrentham, Mass. There he grew up, and though his after fortunes led him back to his birthplace, and the greater part of his life was passed in South Carolina, he remained warmly attached to the home of his boyhood. From school he went to Brown University, and after completing his college course there he studied medicine in Philadelphia, and subsequently practised for a short time with a physician in Boston; but he took a larger and more comprehensive view of his profession than that of the special practitioner, and he went abroad to seek a more general scientific culture. He went through the Medical School at Edinburg, and then travelled on the con-

tinent, making himself familiar with methods of study and practice there. But perhaps nothing in all his European journey had greater influence upon his future life than his stay in Paris, where he worked at the Jardin des Plantes, and became intimate with some of the leading scientific men of the day. He formed relations then which ended only with life, such as his friendship with Valenciennes, with Dumeril, Bibron and others.

On his return to America he was called to the Professorship of Anatomy in the Medical School of Charleston, South Carolina. This appointment decided the outward tenor of his life, and led to the formation of his nearest and dearest ties. He there married Miss Harriet Rutledge. Her remarkable mental gifts, unusual cultivation and high-toned character, made this lady beloved and respected by all who ever knew her. Such a marriage naturally strengthened and confirmed the loftiest purposes of his life. The allusion may seem, perhaps, too personal to be introduced here, but these lives were so closely knit together that it is difficult to speak of one without the other.

From this time forward, Dr. Holbrook, although he became an eminent practitioner in the city which had adopted him, was even more distinguished as a teacher of human anatomy, and finally renounced practice to devote himself to his professorship. Clear, simple and straight forward as a teacher, intimate with the most advanced systems of thought and instruction, he inspired his students with a love of nature, and made them indeed, in not a few instances, naturalists and men of science, as well as physicians. His pupils are among the most cultivated men of the South. His loveable personal qualities endeared him to them, and many of his students lost in him not only a revered teacher, but a well beloved friend.

He found time in the midst of his professional duties not only for the largest hospitality, as simple as it was cordial, of which I have personally the most tender and grateful mem-

ory, but also for his investigations in Natural History, and he published in successive years a series of admirably illustrated volumes upon Herpetology and Ichthyology. This series remains, and will ever remain, a standard work in Natural History. He was still engaged upon his Ichthyology of South Carolina, when all undertakings of that kind at the South were interrupted by the war. Dr. Holbrook was too calm and far-sighted to be swept along by any gust of passion or public excitement. For a long time he tried to stem the current, and hoped that a judicious and wise statesmanship might save the country from civil war. But when all hope of an amicable settlement was over, he shared the dangers of his friends, served as a physician in the Southern army, and old as he was then, seventy years of age, shrank from no hardship or exposure, slept under the army wagon and shared the rations of the common soldier. While he was away upon this service his wife died at Columbia, S. Carolina, where she had taken refuge with her family and friends from the impending siege of Charleston.

Nothing was more characteristic of Dr. Holbrook than the way in which he accepted the end of the war. There was not a taint of bitterness in his feeling, though the result had involved him in the common ruin. The struggle had been fairly fought, he considered the end as final, and was among those who were willing to make all reasonable efforts and concessions for the restoration of peace on a sound basis. He returned with unimpaired affection to his northern friends, for difference of opinion did not, with him, affect private relations in the least. Manly as he was in each word and act of his life, ever ready to stand by his convictions, the freeest discussion of disputed points was always possible with him because of his large liberality and gentle courtesy. After the war he resumed his habit of coming north for the summer. Those of us who had the privilege of being his intimate personal friends, will not easily forget the time when, after five years of separation under such painful cir-

cumstances, he crossed our thresholds again, and took his wonted place in our households. Thenceforth, to the year of his death, he passed his summers in New England. He was a cherished guest under many a northern roof, but his permanent northern home was at North Wrentham, now more commonly called Norfolk. There he died among his brothers and sisters and their families, in the village where his infancy and boyhood were passed, and where he was ever regarded with the tenderest affection and respect.

Prof. Edward S. Morse read the following paper: —

## NOTES ON THE EARLY STAGES OF AN ASCIDIAN (CYNTHIA PYRIFORMIS, RATHKE). BY EDWARD S. MORSE, PH.D.

PLATE I.

In the year 1866, Kowalevsky published a remarkable series of observations on the embryology and early stages of several Ascidians,[1] in which a structure similar, if not identical, with the type characters of the vertebrata was demonstrated.

Professor Kupffer at first doubting, then not only confirms the validity of Kowalevsky's observations, but adds additional facts showing that the nerve mass actually penetrates the tail of the embryo to a considerable length.[2]

The important facts revealed in these investigations have led the eminent naturalists above mentioned, as well as Hæckel, Schultze, and others, to believe that the connecting link between the Vertebrates and Invertebrates had at last been established.

Darwin, with prompt recognition has incorporated the facts in his last work on the "Descent of Man."

Since Kowalevsky's memoir above referred to was published, he has traced out the embryology of Amphioxus[3] in which the closest resemblance is seen between this low vertebrate and similar stages of the Ascidian.

In these unsuspected relations between the Vertebrates and Ascidians through Amphioxus, it is interesting to remark that long ago

[1] Kowalevsky, Mem. Acad. Imp. St. Petersburg, Series VII, Tom. X, 8, 1866.
[2] Kupffer. Schultze's Archiv. für Mikrosk. Anatomie, Bd. 6, 1870.
[3] Mem. Acad. Imp. des Sci. St. Petersbourg, VII Series, Tome XI, No 4.

Goodsir called attention to the resemblance between the phryangeal sac of the Ascidians, and that of Amphioxus.[1] He says "The Lancelet respires by receiving sea water into the anterior compartment of the intestinal tube—this cavity is kept dilated by the elasticity of the numerous filamentous ribs, and this dilatation may be increased by the action of the super-imposed ventral bundles of the lateral muscles. It is contracted by the action of the abdominal muscle. This is a mode of respiration similar to that which prevails in the tunicated mollusks. It is interesting to observe that the branchial membrane of the Lancelet is exactly similar in its peculiar vascularity (ramifications at right angles) to that which lines the branchial cavity of the mollusks just specified. . . . . As in Ascidiæ the entrance of the intestino-respiratory canal is guarded by filaments."

In the recent removal of the Tunicates from the Mollusca, and incorporation of the same with the Vermes by Gegenbaur and others, it is interesting to recall from the memoir of Goodsir above cited, the fact that he calls attention to certain resemblances between Amphioxus and the Annulosa.

"The plan of circulation is simple and in accordance with the primitive condition of the respiratory apparatus, both functions being performed in a manner closely resembling that observed in certain annulose animals. The dorsal vessel corresponding to the heart, or branchial artery, and the abdominal vessel to the aorta of the Lancelet." Ibid., p. 260.

Any scrap of information connected with a subject so profoundly interesting justifies me in bringing forward a single observation made upon the young stages of a sessile Ascidian, *Cynthia pyriformis*, at Eastport, Maine, July, 1870.

John E. Gavit, Esq., of New York, kindly placed the larvæ in my hands for examination. The eggs were noticed in all stages, as well as free swimming larvæ in active motion. These were easily seen with the unassisted eye and looked like gigantic spermatozoa. A special series of observations in another line limited me to a single examination of these interesting forms.

Kowalevsky in the paper above referred to represents on plate II, fig. 26, a delicate membrane bordering the tail like a fin. This is represented as structureless. In the unfolded tail no traces of cartilagenous centra are shown, though he represents these parts as more

[1] Goodsir on the Anatomy of Amphioxus. Royal Society of Edinburg, Vol. XV, part I, page 259.

or less conspicuous while still enclosed in the egg. Kupffer represents the same condition of things in his figures.[1]

In the many free larvæ examined by me, the axial segments were perfectly defined. Fig. 2, plate I, represents two as they rested on the slide. In these, forty segments were counted, four of these segments extending into the body proper, the anterior segment sending off three diverging processes toward the hæmal, or ventral region. Beside the persistence of these segments after the animal was freed from the egg, a remarkable structure not hitherto figured, as far as I am aware, was noticed in the caudal fin, which vividly recalled the fine diverging rays as seen in the embryo fish. These rays were extremely delicate though plainly marked. They ran off nearly parallel to the longitudinal axis of the tail, and were confined to the last five segments, reaching beyond the last caudal segment, to a distance equal to eight segments, as shown in figs. 3 and 4. Those who have seen the caudal fin of the embryo trout with its closely crowded ray lines, will bear witness to the strong similarity between the two. At the junction of the tail with the body, a series of rays of various lengths converging in pairs at the outer border of the membrane, and running off at right angles to the longitudinal axis, were also marked, though of extreme tenuity. This peculiar feature is represented in fig. 2. All of the segments were nucleated, and the tail appeared of uniform length. They were enclosed in a continuous investing sheath which disappeared at the caudal tip. This latter region was granulated. The peculiar black spots, the '*sinnesorgane*,' of which nothing is known, save that they are supposed to be sense organs of some sort, were seen, but nothing definite was made out in regard to them. In fact the structure of the fin only was studied.

Since the above lines were written, Mr. Gavit has placed in my hands for examination a number of embryos, from the same lot studied, which he preserved in a saturated solution of salt and water. These he has since mounted in cells with the same preservative fluid, and though a year and a half has elapsed since these specimens were immersed in the fluid, they are remarkably preserved and reveal certain features not recognized in the living specimens.

Fig. 6 represents one of these preserved specimens. All traces of segments have disappeared, the segments being irregularly broken

[1] Ibid., Taf. IX, fig. 16.

in a series of short, cylindrical masses. Löwig and Kölliker[1] represent the tail of a larval Botryllus with the segments divided in a median line, making a double row of segments running parallel, as well as a double row of smaller cells representing the investing membranes. This condition may represent a later stage, though all the specimens preserved by Mr. Gavit present this peculiar appearance.

With the breaking up of the segments, a contraction of the axis has taken place at the tail, leaving a distinct cavity, this is more plainly shown in fig. 5, where double transverse lines are faintly seen indicating the former presence and position of the segments. The fin is seen as a continuous membrane bordering the entire outline of the animal. The fin rays are very conspicuous and commence just at the junction of the tail with the body and start off at right angles with the longitudinal axis. At the tail they rapidly diverge and finally run parallel with the axis. The wider marks of the fin rays correspond nearly in number to the number of segments in the axis. As these were invisible in the living specimens it is impossible to say whether they agree as to number and position with the segments.

In conclusion it is interesting to add that Savigny, Milne Edwards, Van Beneden, Sars, Kölliker, Dalyell, Agassiz and many others have added their testimony in regard to the existence in many genera of Ascidians of active tailed larvæ, till it was supposed that this appearance of the embryo was characteristic of all Ascidians.

Lacaze Duthiers,[2] however, describes the young of Molgula as presenting a remarkable exception ; the young not having a tail, nor showing any signs of activity, but escaping from the egg with the appearance of Amœba, by flowing out of the egg, a rounded plastic fluid mass, and remaining sedentary at the bottom of the vessel. Albany Hancock[3] on the contrary has observed the embryos of two species of Molgula in which they present all the features of the usual active tailed larvæ, and questions whether Lacaze Duthiers had Molgula at all; for certain reasons, which he presents, he thinks Duthiers, had another genus, Eugyra, under examination. Prof. A. E. Verrill however, in a series of valuable papers on the Ascidians of New England,[4] states in regard to *Lissoclinum tenerum* V. (gen. et sp. nov.) that "the eggs are few and relatively very large. The develop-

[1] Annales des Sciences Naturelle, III Series, Tome V, pl. 7.

[2] Comptes Rendus, Tome LXX, p. 1154.

[3] Annals and Magazine Nat. Hist. IV Series, No. XXXV, p. 358.

[4] American Jour. Science and Arts, Jan. to June 1871, p. 445.

ment of such eggs is direct, without passing through a tadpole-shaped larval state," with the following note, "with the alcoholic specimens it is not possible to trace completely the early stages of this development, or to be perfectly certain that these egg-like bodies are genuine eggs, although some of them appear to contain at first, a germinal vescicle."

Further investigation will probably show that eggs passing through such an anomalous development are different in their nature, and it is not improbable that the simple Ascidian Eugyra and the compound Ascidian Lissoclinum will also present a kind of egg which passes through that course of development supposed to be typical of the class. Prof. Verrill, with his usual caution, expresses a doubt whether the egg-like bodies he observed, were genuine eggs, in the note just quoted.

### EXPLANATION OF PLATE I.

The embryos from which these were drawn were about eight one-hundredths of an inch in length.

Fig. 1. Showing body of embryo and anterior end of axial, cartilaginous rod.

Fig. 2. Two embryos showing fin rays at the junction of the tail with the body.

Figs. 3, 4. Showing caudal fin.

Fig. 5. Tail of preserved specimen showing contraction of axial rod, leaving cavity.

Fig. 6. Entire drawing from preserved specimen, showing breaking up of axial rod with fin rays.

Prof. Agassiz said that he studied the embryology of the Ascidians nearly twenty-five years ago, but that the appearances described by Prof. Morse were new to him and of great interest. He failed, however, to see more than a certain analogy between the embryo Ascidian and Vertebrate. He thought that if the Vertebrates had descended from the Ascidians there ought to be some traces of the process in the geological record but there was no evidence of this.

Dr. Chas. Pickering remarked that the position of Amphioxus among the vertebrates seemed doubtful to him.

Mr. F. W. Putnam said he thought there was no reason for regarding Amphioxus as an adult vertebrate. We

should know the younger stages of the Myxinoids before attempting to decide the question. The Amphioxus has been only found in waters where some species of Myxinoids were abundant, and perhaps is only a young stage of the latter.

The following paper was presented: —

A CATALOGUE OF THE BIRDS OF COOS CO., N. H., AND OXFORD CO., ME.; WITH ANNOTATIONS RELATIVE TO THE BREEDING HABITS, MIGRATIONS, &C. BY C. J. MAYNARD. WITH NOTES BY WM. BREWSTER.

Although many catalogues of the birds of different localities in New England have appeared, yet we remain in ignorance as to the distribution of many of our birds, especially the rarer ones, during the breeding season. I therefore present the following catalogue, because it lies in my power to define more definitely than has hitherto been done, the northern distribution of many species. The Alleghanian and Canadian faunæ meet in the localities of which I write, and I have in a measure been enabled by my observations to draw more clearly the line between them than has been done by previous authors. In this enterprise I have been greatly assisted by my friend, Mr. Wm. Brewster, of Cambridge, who has spent several summers in the region of the White Mountains and southern New Hampshire.

Starting on the north-eastern coast of Maine, near Mt. Desert, the dividing line of these faunæ proceeds in a north-westerly direction along the southern margin of the mountain range which stretches across the State to the White Mountains. Here it declines to the south, reaching quite to Rye Beach. Then once more proceeds north-west along the western borders of the mountain range into Vermont, where it is not my present purpose to trace it.

So abruptly is the line defined in many places by the range of mountains, that some birds which occur in abundance one side are found only as stragglers, or not at all, on the other. This is invariably the case in any country, especially where the dividing chain runs east and west.

I have also given the southern distribution during winter of the

species mentioned, as far as they are known. In this connection I have been aided by notes made during two winters' labor in Florida.[1]

That the reader may better understand the distribution of a given species, quotations are made from several catalogues of neighboring localities, viz.: Mr. Wm. Couper's Birds of Quebec, as published by Mr. E. A. Samuels, in the "Birds of New England and adjacent States"; a list of the birds found at Norway, Oxford Co., Me., by Prof. A. E. Verrill (Proceedings of Essex Institute, Vol. III., p. 136–160); and a Catalogue of the Birds observed near Hamilton, Canada West, by Mr. T. McIlwraith (Proceedings of the Essex Inst., Vol. V., p. 78–96). These quotations are accredited to the individuals from whom they are taken, in every instance, for convenience in reference. I am also indebted to Mr. R. Deane, of Cambridge, Mr. H. B. Bailey, of Boston, and others, for valuable notes, to all of whom I have endeavored to give due credit.

It is not to be supposed that all the species occurring in these localities are given in the catalogue, but only those that have been observed.

## TURDIDÆ.

1. **Turdus migratorius** Linn. Robin.

Not very common. I found it breeding the first week in June, about Lake Umbagog; some of the nests contained young, but in the majority the eggs were freshly laid. Indeed, as late as June 5th, I saw nests scarcely completed. It is given as nesting the second week in May, at Norway (Verrill). This wide difference between the former and latter places is surprising, inasmuch as Lake Umbagog is only thirty miles north of Norway. Although this bird is known to have a high northern distribution, it is not given by Couper as a bird of Quebec.

2. **Turdus fuscescens** Steph. Wilson's Thrush.

Not common either at Norway (Verrill), Franconia (Brewster), or at Umbagog. Breeds probably at Upton, during the second week in June. This species is given as breeding commonly about Quebec (Couper).

3. **Turdus Pallasii** Cab. Hermit Thrush.

Not very common. Two nests were taken at Upton, on June 5th, containing three fresh eggs. Another, found on the 9th, contained three newly hatched young. All the nests were built on the tops of old, moss-covered logs.

[1] The results of the researches will soon appear in a volume entitled "The Birds of Florida," by the author of this paper.

4. **Turdus Swainsonii** Cab. Olive-backed Thrush.

The most common of all the Thrushes. Its loud, echoing, and melodious song greets the ear in every wooded valley. Breeds; nesting either in small evergreens or on the lower branches of higher ones. Several newly completed nests were found the first week in June, and on the 9th one was taken containing two fresh eggs. Although common at Franconia (Brewster), I do not think it is to be found in summer south of the neighboring mountain-range, for it is not given in the Norway list (Verrill). As this is its extreme southern limit during the breeding season, the specimens are of a much smaller size, and generally darker colors than those from further north.[1]

5. **Seiurus aurocapillus** Sw. Golden-Crowned Thrush.

Common. Breeds; a nest was found on June 9th, containing four fresh eggs.

6. **Seiurus Noveboracensis** Nutt. Water Thrush.

Common. Breeds; probably about the second week of June. Frequents thickets along the margins of the lakes and water-courses. It is extremely shy, and is seldom seen, for it runs nimbly about on the ground, beneath the thick undergrowth and fallen trees. Its beautiful warbling song, however, always betrays its hiding-place. "Common at Franconia in summer" (Brewster). Said to breed somewhat rarely at Norway (Verrill). Given as a common summer resident at Hamilton (McIlwraith).

## SAXICOLIDÆ.

7. **Sialia sialis** Bd. Blue-Bird.

Not very common at Umbagog. Breeds. More numerous at Norway (Verrill). "Only seen here (Quebec) in early Spring, while on its passage to the West. Does not breed in Lower Canada." (Couper).

## PARIDÆ.

8. **Parus atricapillus** Linn. Black-capped Titmouse. Chick-a-dee.

Common. Breeds. Two nests, containing nearly fresh eggs, were taken June 18th. I found it very common in Coos County, New

[1] This merely illustrates a well known law in nature; southern born birds, of the same species, being always smaller and darker than those born further north. This is especially noticeable upon comparing birds taken in Massachusetts during the breeding season, with those from the southern portion of Florida.

Hampshire, in November. Specimens taken during the breeding season at Upton have less rufous on the under parts than those taken at the same time in Massachusetts; there is, however, no appreciable difference in size.

9. **Parus Hudsonicus** Forster. Hudson-Bay Titmouse.

I found it quite common, and associating in flocks with the preceding species in the heavily-wooded mountain valleys of Errol, New Hampshire, during the latter part of October, 1869. I also took two specimens at Albany, Maine, on October 22d, but did not see it in this place previous to this date. Common at Quebec (Couper) during autumn. Resident near Calais (Boardman). Not given as a bird of Norway (Verrill), or of Hamilton (McIlwraith). Mr. Brewster took a single specimen at Concord, Massachusetts, on October 29th, 1870. The song-note of this species somewhat resembles that of *P. atricapillus*; it is harsher, however, and more quickly given.

## SITTIDÆ.

10. **Sitta Carolinensis** Gm. White-bellied Nuthatch.

Common resident. Breeds (Verrill). Common at Errol, New Hampshire, and Oxford County in October and November. Did not see it at Upton in June. Not given as occurring at Quebec (Couper), or at Gorham and Franconia (Brewster).

11. **Sitta Canadensis** Linn. Red-bellied Nuthatch.

Very common resident. Breeds; probably at Umbagog during the latter part of May. This species has a more northern distribution than *S. Carolinensis*, and does not occur so far south either during the breeding season or in winter. It was common in the same localities as the preceding at Errol, in November, 1870. They were both seen in flocks, yet in no instance did I find them associating together. It changes its usual sharp, querulous note during the breeding season for one more deliberate. Indeed, when heard in the deep woods where the bird is always found, it sounds very grave and solemn.

## CERTHIIDÆ.

12. **Certhia familiaris** Linn. Brown Creeper.

Common at Upton in summer, where it must breed. Given as a common resident at Hamilton (McIlwraith). Not common, but breeding at Norway (Verrill), and as common and breeding at Quebec (Couper). Saw a few at Bethel in October, but did not meet with it in Coos County a little later in the season. Massachu-

setts is probably its southern limit during the breeding season. North, it extends probably to the barren grounds. During summer this bird sings a low, warbling song, but at other seasons it has only the usual sharp, hissing note.

## TROGLODYTIDÆ.

13. **Troglodytes aëdon** Vieill. House Wren.

Common summer resident (Verrill). Rare at Umbagog, and as it is not given at Quebec by Couper, this may be its extreme northern limit.

The so-called *T.* "*Americana*" is given by Verrill as a bird of this section. This is, however, a doubtful species founded probably on specimens of *T. aëdon* of a larger size, and generally darker colors.[1]

14. **Troglodytes hyemalis** Vieill. Winter Wren.

Common at Franconia and Gorham (Brewster). Very common at Umbagog during the breeding season. I also found it quite abundant at Bethel, in October, 1869. Given as breeding commonly at Quebec (Couper). Not given as nesting at Hamilton (McIlwraith), or at Norway (Verrill). The mountain range south of Upton may, therefore, form the barrier of its extreme southern limit during summer. This bird frequents the thickets and heaps of fallen trees, generally in the deep woods. It is extremely shy, and were it not for its most beautiful and continuous warbling song, which is heard at intervals throughout the day, it would pass almost unnoticed; for upon the approach of man it instantly hides. Indeed, it often remains concealed while singing, for I have, in many instances, stood within a few yards of its retreat, and listened to its indescribable melody without being able, with the closest attention, to detect the singer. It probably deposits its eggs in those secluded spots.

## MOTACILLIDÆ.

15. **Anthus Ludovicianus** Licht. Tit Lark.

Given as common at Quebec (Couper) in autumn, and at Hamilton (McIlwraith), during spring and fall. Not given as occurring at Norway (Verrill). I did not meet with it either in Oxford or Coos counties during October and November of 1869. I have always found this species occurring on the sea-coast much more abundantly during the migrations than inland, which may account for its non-appearance in the above-named localities. It winters in Florida.

[1] See author's "Naturalists' Guide," Part II., Page 94.

## SYLVIIDÆ.

**16. Regulus calendulus** Licht. Ruby-crowned Wren.

Given merely as a bird of passage at Quebec (Couper), Hamilton (McIlwraith), and (Verrill). I found it common at Bethel on my arrival there October 13th, 1869, but by the 22d they had all disappeared. It was not to be found at Umbagog in June. This bird probably breeds far to the north, yet it winters in the Carolinas and northern Florida, where they are very numerous. They do not visit the southern section of this latter named State in numbers, and I have never found it on the Keys.

**17. Regulus satrapa** Licht. Golden-crowned Wren.

Quite common at Umbagog in June. Breeds; and judging from the condition of female specimens taken, lays its eggs about June 1st. Although we found several pairs in the thick hemlock woods, that evidently had nests in the immediate vicinity, yet we were unable to discern them. It probably builds in the long hanging moss that grows so abundant on the trees in these northern forests. Given as perhaps breeding rarely at Norway (S. I. Smith). Not given as breeding or wintering at Hamilton (McIlwraith), or Quebec (Couper). Although this species does not visit so high latitude as the preceding, it is much more limited in its migrations; many spend the winter in Massachusetts, and from thence it scatters southward to the Carolinas, which is nearly its southern limit, for only stragglers ever reach northern Florida. The song note during the breeding season is a series of low, shrill chirps, terminating in a lisping warble.

## SYLVICOLIDÆ.

**18. Mniotilta varia** Vieill. Black and White Creeper.

Not common, but breeding at Norway (Verrill). Breeds rarely in the neighborhood of Quebec (Couper). Common spring and autumn at Hamilton (McIlwraith). We did not see it at Upton in June. Mr. Brewster never met it at Gorham or Franconia.

**19. Parula Americana** Bon. Blue-yellow backed Warbler.

Common at Upton during the breeding season. Not given by Couper at Quebec. Not common during the breeding season at Norway (Verrill). Does not breed at Hamilton (McIlwraith). Does not breed very far north. The majority winter in the West Indies and adjacent islands. It passes through Florida in autumn about October, and in spring during early March. Some few remain all winter at Key West.

**20. Geothlypis trichas** Cab. Maryland Yellow-throated Warbler.

Common during summer at Norway (Verrill), Hamilton (McIlwraith), and Quebec (Couper). Not very common at Umbagog in June. Breeds about June 8th. A widely distributed species, breeding over nearly the whole continent of North America.

**21. Geothlypis Philadelphia** Baird. Mourning Warbler.

Common at Umbagog in June. Breeds. Mr. Brewster has taken the nearly fledged young at Franconia in spring (McIlwraith). Not given at Quebec (Couper), or at Norway (Verrill). It frequents the bushes along fences, stone walls and the edges of woods. The male may be seen in the early morning perched on the top rail of a fence, or dead branch of a tree singing. The song is loud and clear, somewhat resembling that of the Water Thrush.

**22. Helminthophaga ruficapilla** Baird. Nashville Warbler.

Not very common at Umbagog during summer. Breeds about June 1st. Rare at Norway during summer (Verrill). Common at Hamilton (McIllwraith), Franconia and Gorham (Brewster). Not given by Couper at Quebec. This is no doubt the northern limit of this species.

**23. Helminthophaga peregrina** Cab. Tennessee Warbler.

Very common at Umbagog during the breeding season. Also at Milltown, Maine (Boardman). Not given by McIlwraith at Hamilton, Couper at Quebec, by Verrill at Norway, or by Brewster at Gorham and Franconia. This beautiful little species breeds at Upton; two or three females were taken about June 8th, which showed every evidence of incubating, yet we were unable to discover the nest, though diligent search was made for it in localities near where it must have been built. The nest is probably placed on the ground after the manner of all this genus. This bird is found in all wooded localities in the region north of the neighboring mountain range, which is without doubt its southern limit during the breeding season. Its song bears a resemblance to that of *H. ruficapilla*, only the notes of the first part are more divided and the latter part is shriller. The male, while singing, is generally perched on some high, dead branch. In this habit it resembles the *H. ruficapilla* and *H. chrysoptera*.

**24. Dendrœca virens** Baird. Black-throated Green Warbler.

Not very common at Norway (Verrill), or at Upton during the breeding season. Seen only during the migrations at Quebec (Couper), and Hamilton (McIlwraith). Massachusetts is probably the southern limit of this species during summer. It may breed as far north as the barren ground region.

**25. Dendrœca cærulescens** Baird. Black-throated Blue Warbler.

Common, and breeding at Upton and Quebec (Couper). Not common at Norway during the summer (Verrill). A spring and autumn migrant at Hamilton (McIlwraith). This is perhaps another northern species that finds its southern limits in this region during summer. It winters in the West Indies and adjacent islands, passing through the western section of Massachusetts (Allen) more abundantly than the eastern, and so on through the intervening States into Florida. A few remain at Key West all winter.

**26. Dendrœca coronata** Gray. Yellow-rumped Warbler.

Common during the breeding season at Upton. Breeds. Not known to breed at Quebec (Couper), Hamilton (McIlwraith), or at Norway (Verrill). They nest about the second week in June, at Upton. Three nests were found by Mr. H. B. Bailey, on June 7th and 8th. They were all built in low spruce trees, about four feet from the ground; and were rather neat structures, being made of hemlock twigs and lined with a few feathers. They each contained four fresh eggs. Several other nests were taken by Mr. Bailey between the 8th and 15th. This is also a strictly northern species, but rarely breeds south of the White Mountain Range. They winter in great numbers in Florida and the West Indies, but I did not find it at Key West or on any other of the Florida Keys.

**27. Dendrœca Blackburniæ** Baird. Mrs. Blackburn's Warbler.

Common at Upton. Breeds. Not uncommon at Norway during the summer (Verrill). Seen only on the migrations at Quebec (Couper), and Hamilton (McIlwraith). This highly-colored warbler frequents the tops of high trees in the thick woods; it is therefore difficult to obtain. I think it must build its nest on the topmost limbs of the spruce or hemlock, where it is concealed by the hanging

moss, as we were unable to detect it, although the bird was plentiful. It has a very pretty song.

**28. Dendrœca castanea** Baird. Bay-breasted Warbler.

Most abundant of the *Sylvicolidæ* at Umbagog. Breeds. Observed only in spring at Quebec (Couper). Seen rather rarely in spring at Hamilton (McIllwraith). Very rare at Norway (Verrill). Two nests of this species were taken at Umbagog on June 8th. The tree selected by the birds belonging to the first nest discovered, as a summer home, stood by the side of a cart-path in the woods. My attention was attracted to it while walking along, by seeing the female fly into the tree and alight on the nest which was then (June 3d) but just completed. It was placed on the horizontal branch of a hemlock twenty feet from the ground, and five or six feet from the trunk of the tree. On June 8th the nest was taken, and then contained three fresh eggs. The second nest was found by Mr. Brewster who, having shot a female that exhibited signs of nesting, searched for the nest, and discovered it in a hemlock tree on the side of a thickly wooded hill. This nest contained only two fresh eggs. It was likewise placed on a horizontal branch about fifteen feet from the ground. The nests are both large for so small a bird, and resemble that of the Purple Finch. The first one is composed outwardly of fine, dead twigs, from the larch, among which are scattered a little of the long tree-moss. It is very smoothly and neatly lined with black, fibrous roots, the seed stalks of a species of ground moss, a few hairs of *Lepus Americana*, and a single piece of green moss that grows in damp woods. The dimensions are; diameter externally, six inches; internally, three inches ; depth, externally, two and one-half inches; internally, one and one-fourth. It contained three eggs, of which the following is a description : No. 1 is bluish green, thickly spotted with brown over the entire surface, with a ring of nearly confluent blotches of brown and lilac at the larger end. The dimensions are: $71 \times 53$.[1] No. 2 resembles No. 1, with the exception that there are some amber spots in the ring around the larger end, and the smaller end is immaculate. Dimensions, $65 \times 50$. No. 3 is less spotted than the others, and has a few brown lines on the larger end. Dimensions, $70 \times 50$. No. 1 is the most perfect in form. No. 2 rather rounder, while No. 3 is long for the width. The second nest also resembles the first, but contains a few stalks of grass near the centre.

[1] Hundredths of inches.

It is lined with the same materials as the other, excepting, the green moss. The dimensions are; diameter externally, five and one-half inches; internally, two and one-half; depth externally, three inches; internally, one and one-half. Description of the eggs: No. 1, bluish green, with a ring of spots and blotches of brown and lilac around the larger end. The remainder of the surface is somewhat sparsely spotted and blotched with the same, the smaller end being nearly immaculate. A few of the spots are of a deep umber color. Dimensions, 70 × 53. No. 2 same as No. 1, but with the spots on the larger end more diffused, and nearly covering it, the remainder of the egg much less spotted than in the preceding. Dimensions, 70 × 52. Both of the eggs are perfect in form. Upon dissecting the female two more eggs were found that would have been laid.

Another nest was found, but contained no eggs. It was built in a similar position as the two preceding, and composed of much the same materials. Its dimensions are; diameter externally, five and one-half inches; internally, two and one-half.

Mr. R. Deane found a warbler's nest at Umbagog, in June, 1870, which upon comparison with those taken the present season, proves it to be without doubt that of this species. It was placed in a hemlock somewhat higher than those already described, but was constructed in the same manner.

It contained six eggs. The following is a description of four which are now before me. No. 1, bluish green, spotted and blotched on the larger end with lilac, brown and umber. The remainder of the surface finely spotted with the same, smaller end nearly immaculate. Dimensions, 70 × 55. No. 2 almost a counterpart of No. 1 in colorations. Dimensions, 72 × 55. No. 3 is also similar in markings, there is, however, an irregular ring of deep umber spots around the larger end. Dimensions 75 × 55. No. 4 is very different from the others. The ground color is the same, but it is blotched with pale brown and lilac, thickly at the larger end and more sparsely towards the smaller where the spots are finer. There is also a large irregular blotch of pale brown on one side of the larger end. Dimensions, 72 × 53. Nos. 1 and 3 are most perfect in form, No. 2 is narrow for the length, while No. 4 is short for the width.

These birds are found in all the wooded sections of this region, where they frequent the tops of tall trees. The first part of the song is like that of the Black-poll Warbler, but it has a terminal warble

similar to that of the Redstart, to which it bears a striking resemblance, with the exception that it is given with less energy. This species seems to be confined during the breeding season to the region just north of the White Mountains range.

This species, together with *Geothlypis Philadelphia* and *Helminthophaga peregrina*, seems to pursue a very eccentric course during the migrations. Avoiding the eastern and middle States, the majority pass along the borders of the Great Lakes, through Ohio, southern Illinois (Ridgway[1]), down the Mississippi Valley, across into Texas, and so on into Mexico and Central America where they winter. Returning in spring they (at least *D. castanea*) pursue a more southern route, keeping along the coast as far as the New England States, where they ascend the Connecticut Valley, generally avoiding eastern Massachusetts.

**29. Dendrœca striata** Baird. Black-polled Warbler.

Not common at Umbagog, Hamilton (McIlwraith), or at Norway (Verrill) during the migrations. Breeds at Quebec (Couper). They disappeared from Upton about June 5th. This species breeds very far north, probably in Labrador. Some few winter in the West Indies, but the greater part pass into South America. I have never seen it in Florida or on the Keys.

**30. Dendrœca pinus** Baird. Pine Warbler.

Common during the migrations at Hamilton (McIlwraith). Probably occurs rarely in the southern sections of Oxford county, but this is far north of its usual range. This species breeds from Florida to Massachusetts. They winter in great numbers in the pine woods of the main-land of Florida.

**31. Dendrœca Pennsylvanica** Baird. Chestnut-sided Warbler.

Common at Hamilton (McIlwraith) during the summer. Rather common at Norway (Verrill), but not very abundant at Umbagog or at Quebec (Couper). Breeds at all the above mentioned localities; it may, however, find its northern limit somewhere about Quebec. This species mainly winters in Mexico and Central America. They, however, follow the coast during both migrations.

**32. Dendrœca æstiva** Baird. Yellow Warbler.

Given as abundant by McIlwraith, at Hamilton, Couper at Quebec, and Verrill at Norway. Although this bird is known to have

[1] In Mss., June, 1870.

a high northern distribution, we did not see it at Upton, but it was common at Bethel about June 4th. This is another species that finds its winter home in South America.

**33. Dendrœca maculosa** Baird. Black and Yellow Warbler.

Common at Umbagog, Quebec (Couper), and rather common at Hamilton (McIlwraith), during the breeding season. Rare at Norway (Verrill) only during the migrations. A nest of this species was taken during the second week in June, 1870, at Umbagog, by Messrs. R. Deane and H. B. Bailey. The following is the description of the nest and eggs kindly given to me by Mr. Deane. "The nest was placed on the forked branch of a low spruce, about three feet from the ground on a rising piece of land, leading from a wood path. The nest, which contained four eggs, was constructed of dry grass, spruce twigs, roots, etc., and was lined with fine black roots, the whole being a coarse structure for so dainty a looking warbler. The eggs were more spherical than any warbler's I have ever seen. The ground color is a creamy white, blotched sparingly over with large spots of lilac and umber.

"The dimensions were: No. 1, 62 × 52; No. 2, 61 × 52; No. 3, 62 × 50; No. 4, 63 × 52."

Another nest, taken by Mr. Brewster, June 8th, 1871, was built in a similar locality, but was placed on a low hemlock about four feet from the ground. The following is a description of the nest. It is composed outwardly of a few scattering, dead twigs of larch, interwoven with stalks of weeds and dry grass. It is lined with black horse hairs. Mr. Brewster says "this dark lining formed a strange contrast with the faded appearance of the outer part. The whole structure is very light and airy in appearance, strongly reminding one of the nest of *D. Pennsylvanica*." Dimensions of the nest are; external diameter, three inches; internal diameter; two; external depth, one and three quarter inches; internal depth, one and one-quarter. The descriptions of the eggs are: No. 1, ashy-white, with a ring of brown and clouded lilac around the larger end. The remainder of the surface is thinly mottled with minute spots of brown. Dimensions 65 × 50. No. 2 similar to No. 1, but with a large irregular blotch of burnt sienna on one side of the larger end. Dimensions, 62 × 47. No. 3, not so thickly marked with spots as the others, but otherwise similar. Dimensions, 64 × 46. No. 4, is more sparingly spotted than any. Dimensions, 65 × 48.

A nest that I found June 7th, 1871, built in a small hemlock that grew on a hillside, was composed from grasses and fibrous roots and is lined with horse hair. Its dimensions are: external, three and three-fourth inches; internal, two inches; external depth two and one-fourth inches; internal, one and one-half. The eggs, four in number, were fresh. The descriptions are: No. 1, ashy-white, circle of brown and pale lilac spots or blotches around the larger end, remainder of the surface sparsely spotted with the same. Dimensions 65 × 53. No. 2 is nearly the same as No. 1. Dimensions, 67 × 50. No. 3 has the spots extending more to the smaller end. Dimensions, 64 × 50. No. 4 is somewhat like the others, it is, however, marked with lines of deep umber and has a large irregular blotch of very pale brown on one side near the smaller end. Dimensions, 65 × 52.

I found a second nest June, 8th, by the side of a public road, near a wood. This also was built in a low hemlock not over four feet from the ground. The nest is composed of larch twigs, tree moss, and silk from the nests of spiders, all closely interwoven. It is smoothly lined with black and brown fibrous roots. Its dimensions are: external diameter, four inches; internal, two and one-fourth. External depth, two and one-fourth inches; internal, one and one-half. The eggs were four in number, and almost exact counterparts of those already described. Both of these nests were very compact and pretty structures. The White Mountain range is the southern limit of this bird in summer. During the spring and autumn migrations it follows *D. castanea*, and spends the winter in the same locality.

**34. Dendrœca palmarum** Baird. Yellow Redpoll Warbler.

Common at Norway (Verrill), spring and fall. Rare at Hamilton (McIlwraith) during the same seasons. Not given as a bird of Quebec by Couper. We did not see it at Upton in June. I think this species breeds in the barren grounds of Labrador, along the sea-coast. It winters in large numbers in Florida, on the Keys, and at the West Indies and adjacent islands.

Perhaps the Cerulean Warbler (*D. cerulea*) may occur, as it is given as a bird of Quebec (Couper), and of Hamilton (McIlwraith).

**35. Perissoglossa tigrina** Baird. Cape May Warbler.

Common at Umbagog. Breeds. Rare at Hamilton (McIlwraith), and in southern Maine (Boardman). Not given by Couper at Quebec. This species frequents the thick evergreen woods, keeping in the tops of the trees. I think it must breed high above the ground

in some of the immense spruces or hemlocks of this region. Females were taken the second week in June that bore marks of incubating, yet we were unable to find its nest. This species winters in the West Indies, and a few remain at Key West, where they are abundant during the migrations. I think it must reach its winter quarters by way of the Great Lakes and Mississippi Valley, as it does not occur in any numbers in Massachusetts.

36. **Myiodioctes pusillus** Bon. Black-capped Fly-catching Warbler.

Not common at Norway (Verrill) and Gorham (Brewster) during summer. Rare at Hamilton (McIlwraith). Not given at Quebec (Couper). We did not see it at Umbagog in June. Not found at Franconia (Brewster).

37. **Myiodioctes Canadensis** Aud. Canada Fly-catching Warbler.

Common at Umbagog, also at Quebec (Couper), and at Norway (Verrill). Not rare at Hamilton (McIlwraith). It breeds at all these places. Nests at Umbagog about the second week in June. It probably winters in Mexico and Central America.

38. **Setophaga ruticilla** Sw. Redstart.

Common at Upton, Quebec (Couper), Hamilton (McIlwraith) and at Norway (Verrill). Breeds in all these localities. Winters in the West Indies. Passes through Florida on its way north in April.

## HIRUNDINIDÆ.

39. **Hirundo horreorum** Bart. Barn Swallow.

Abundant at Umbagog.

40. **Petrochelidon lunifrons** Bd. Cliff Swallow.

Common everywhere. Breeds; nesting at Umbagog about the middle of June.

41. **Tachycineta bicolor** Cab. White-bellied Swallow.

Common everywhere. Breeds at Umbagog, nesting in old decaying stubs that have their bases submerged in the lake. It either excavates a hole for itself, or selects one formerly used by a woodpecker. I have seen two holes in one stub. Lays its eggs the second week in June.

42. **Cotyle riparia** Boie. Bank Swallow.

Common everywhere.

**43. Progne subis** Bd. Purple Martin.

Also common everywhere. All of the above *Hirundinidæ* have a wide distribution, and winter far south.

## VIREONIDÆ.

**44. Vireo olivaceus** Vieill. Red-eyed Vireo.

Abundant at Umbagog, Hamilton (McIlwraith) and Norway (Verrill). Breeds. Not common at Quebec (Couper). They winter in South America.

**45. Vireo gilvus** Bonap. Warbling Vireo.

Common at Norway (Verrill), and Hamilton (McIlwraith). Not found at Umbagog or at Quebec. I think the White Mountain range forms its northern limit. Probably winters far south.

**46. Vireo solitiareus** Vieill. Solitary Vireo.

Common at Umbagog and at Franconia (Brewster). Breeds. Not given by Couper at Quebec. Rare at Hamilton in spring (McIlwraith). Not common at Norway (Verrill). Massachusetts forms the extreme southern limit of this species during the breeding season. It winters in Florida.

## AMPELIDÆ.

**47. Ampelis cedrorum** Baird. Cedar Bird.

Common at Hamilton (McIlwraith), Quebec (Couper), Norway (Verrill), and Umbagog. Breeds in all these places; nesting in the last named about the 15th of June.

The Bohemian Wax-wing may occur in winter, as it is given by Couper at Quebec, and by McIlwraith at Hamilton.

## LANIIDÆ.

**48. Collurio borealis** Baird. Northern Shrike.

Common at Bethel and in Coos county in autumn and winter. Breeds far north.

## TANAGRIDÆ.

**49. Pyranga rubra** Vieill. Scarlet Tanager.

Common at Hamilton (McIlwraith). Rare at Norway (Verrill), Umbagog and Quebec (Couper), which place must be its northern limit. The majority pass the winter in South America.

## FRINGILLIDÆ.

**50. Pinicola Canadensis** Cab. Pine Grossbeak.

Common in winter in Coos and Oxford counties, arrives from the north about the 1st of November. This species has a high northern range in summer.

**51. Carpodacus purpureus** Gray. Purple Finch.

Common at Umbagog, Norway (Verrill) and Quebec, (Couper). Not common in summer at Hamilton (McIlwraith). This species has a northern distribution, and does not migrate very far south in winter.

**52. Chrysomitris tristis** Bon. Gold Finch.

Common, and breeds at Umbagog, Norway (Verrill), and Quebec (Couper). It does not winter at any of these places. Resident at Hamilton (McIlwraith). Winters from Massachusetts to southern Florida.

**53. Chrysomitris pinus** Bon. Pine Finch.

Common at Umbagog in June. Migrant at Norway (Verrill). Winter visitant at Hamilton (McIlwrath), and at Quebec (Couper). Not common at Franconia in summer. Breeds at Gorham in August (Brewster). This species is quite irregular in its migrations, being governed by the supply of food.[1] Sometimes they barely reach Massachusetts in winter, and at other seasons occur in Florida.

**54. Curvirostra Americana** Wils.

Common at Umbagog, according to Mr. Deane, during the summer of 1870. Very common at Franconia in summer (Brewster). Winter visitor at Norway (Verrill), Hamilton (McIlwraith), and Quebec (Couper). I did not see it at Bethel, or in Coos county in October and November, 1869.

**55. Curvirostra leucoptera** Wils. White-winged Crossbill.

Very numerous at Bethel, and in Coos county in October and November, 1869. Common at Umbagog in June, 1870 (Deane), and at Franconia in summer (Brewster). Common in winter at Norway (Verrill), and Quebec (Couper). Rare in winter at Hamilton (McIlwraith). Both of these species sometimes migrate far south of Massachusetts in winter. The latter species, however, has a higher northern distribution than the former.[2]

[1] See "Naturalist's Guide," Part II, page 10.

[2] For remarks upon these species, see "Naturalist's Guide" Part II, page 112.

**56. Ægiothus linarus** Cab. Redpoll Linnet.

Common in winter throughout the New England States during certain seasons. They disappeared entirely from Bethel and Albany in the latter part of November, 1869. I did not see it in Coos county during the first week in November. It is found far north.

**57. Plectrophanes nivalis** Meyer. Snow Bunting.

Common in winter throughout New England. I found it in Coos county in the latter part of October, 1869, although generally breeding far north. This species may breed on the tops of some of the ranges of Maine and New Hampshire. I have a note of a well authenticated instance of a large flock being seen on Mount Katahdin, in early August, 1869.

**58. Plectrophanes Lapponicus** Sel. Lapland Long-spur.

This species may perhaps occur, as it is given at Hamilton (McIlwraith). I have ever found it, however, a bird of the coast.

**59. Passerculus savanna** Bon. Savannah Sparrow.

Common in summer at Norway (Verrill), Hamilton (McIlwraith), and Gorham (Brewster). Not rare at Umbagog, which is without doubt nearly its southern limits, for it is not given by Couper as a bird of Quebec. It winters in the southern States.

**60. Poœcetes gramineus** Baird. Grass Finch.

Common throughout New England. Breeds from Maryland to the far north. Winters in the southern States.

**61. Zonotrichia leucophrys** Sw. White-crowned Sparrow.

Common, and breeding at Quebec (Couper). Not rare spring and autumn at Hamilton (McIlwraith). Not common at Norway (Verrill), during the same seasons. I saw one or two specimens at Albany, in October, 1869. Not found at Upton in June. This bird seems to occupy the eastern and seaboard portions of the north during the breeding season. Quebec is nearly its southern limit at this time. It probably winters in the south-western States, pursuing much the same course to reach them as is followed by *D. castanea.*

**62. Zonotrichia albicollis** Bon. White-throated Sparrow. "Peabody Bird."

Common and breeding throughout the northern portions of the New England States. Does not breed at Hamilton (McIlwraith). Occurs plentifully from about latitude 14° to the far north, keeping the middle districts, being replaced on the eastern coast by *Z. leucophrys* and on the western by *Z. Gambelii.* It winters in the southern States, east of the Mississippi. Breeds at Umbagog the first week in

June. Builds on the ground by the side of a stump or log; frequently by the road-side.

63. **Junco hyemalis** Sclater. Blue Snow-bird.

Common and breeding in the district north of Franconia. Nests in early June. Generally builds on the ground, but Mr. H. B. Bailey found one that was placed in a low spruce four feet from the ground. Disappeared from Bethel in 1869 about November 10th. Winters from Massachusetts to the Carolinas.

64. **Spizella monticola** Baird. Tree Sparrow.

Did not see it at Umbagog in June. Breeds far north. Given as wintering at Norway (Verrill), and at Hamilton (McIlwraith). Disappeared from Bethel at the same time as the preceding; associating with them while they remained, in large flocks. Winters in the southern, New England and middle States.

65. **Spizella pusilla** Bon. Field Sparrow.

Common at Norway (Verrill), and Hamilton (McIlwraith). We did not find it at Umbagog in June. Not given by Couper at Quebec, or by Brewster at Franconia. I think the White Mountain range forms its northern limits. It winters in Florida and the other eastern-southern States.

66. **Spizella socialis** Bon. Chipping Sparrow.

Common in all the New England States in summer. Given at Quebec (Couper), as common and breeding. It probably finds its northern limits not far from this point, however. Winters in Florida and the extreme southern States east of the Mississippi.

67. **Melospiza melodia** Baird. Song Sparrow.

Common in the New England States and Canada in summer. Breeds. Winters from Massachusetts to northern Florida. Breeds at Umbagog the last week in May. I found it in Coos county the first week in November, when the snow was on the ground.

68. **Melospiza palustris** Baird. Swamp Sparrow.

Not uncommon in the New England States in summer. Given as rather rare at Quebec (Couper). Breeds at Umbagog about the first week in June. Winters in Florida and the Gulf States.

69. **Passerella iliaca** Sw. Fox-colored Sparrow.

Given by Couper as breeding not commonly at Quebec. This is probably its southern limits during summer. Breeds plentifully in Labrador, and far north. We did not find it at Umbagog in June. Common in all the New England States, spring and autumn. Winters in the eastern Southern States north of Florida.

**70. Guiraca Ludoviciana** Sw. Rose-breasted Grosbeak.

Not common at Umbagog, Norway (Verrill), or Quebec (Couper). The last named place is its northern limit; breeds from this point to Maryland. Winters in Mexico and Central America.

**71. Cyanospiza cyanea** Baird. Indigo Bird.

Common at Hamilton (McIlwraith), and at Norway in summer (Verrill). Not common at Umbagog or Quebec (Couper). This last named place is nearly its northern limit. This species has a wide distribution in summer. Winters in Mexico and Central America.

**72. Pipilo erythropthalmus** Vieill. Tohee Bunting.

Not common at Norway in summer (Verrill). Not found north of the White Mountain range, or at Franconia (Brewster). From this point it is found breeding southward to Georgia. Winters in the eastern Southern States and northern Florida.

## ALAUDIDÆ.

**73. Eremophila alpestris** Linn. Shore Lark.

Given as wintering, by Verrill, at Norway, but I did not see it in October or November at Bethel. It is a bird of the coast in New England. Breeds north and west.

## ICTERIDÆ.

**74. Dolichonyx oryzivorus** Sw. Bobolink.

Very common at Norway (Verrill). We saw it at Bethel in June, and so along the road-side to the mountain range at Newry. Not seen at Umbagog, but Couper gives it as breeding commonly at Quebec, which he says is its northern limit. Winters in the West Indies.

**75. Molothrus pecoris** Sw. Cow Blackbird.

Given as breeding commonly at Norway (Verrill). Winters in the Southern States and northern Florida.

**76. Agelæius phœniceus** Vieill. Red-winged Blackbird.

Common throughout the whole eastern section of the United States, and far north. There is but little difference in the time of breeding between those individuals which occur in southern Florida and Umbagog. During the last week in April, 1871, I found nests just completed in the Everglades of Florida, and about May 1st found them nesting in hollow stubs on the Keys. May 10th I found fresh eggs at Ipswich, Mass., and June 1st they were apparently incubating at Umbagog. Winters in the Southern States and Florida Keys,

but I do not think individuals from the far north ever pass South Carolina.

77. **Icterus Baltimore** Daud. Baltimore Oriole.

Common, and breeding at Norway (Verrill), and Bethel. Does not occur north of the White Mountain range. This species has a wide distribution. Winters in Mexico and Central America.

78. **Scolecòphagus ferrugineus** Sw. Rusty Grakle.

Common, and breeding in the valley of the Magalloway (Samuels). Saw a few at Umbagog in June. Another species whose southern limit is the White Mountain range. Winters in the Southern States and Florida Keys.

79. **Quiscalus versicolor** Vieill. Crow Blackbird.

Common throughout eastern United States. There is even less difference in the time of breeding of this species than *A. phœniceus.* They were not nesting, but apparently about to do so, on the Florida Keys, May 1st. Nesting at Ipswich, Mass., May 2d, and Messrs. Brewster and Bailey found a nest in a hollow stub which stood in the lake, with large embryos in the eggs, June 3d. Winters in the Southern States.

## CORVIDÆ.

80. **Corvus carnivorus** Bart. Raven.

Common on the Chatham flats (McIlwraith). Two shot by J. G. Rich at Richardson's Lake (Deane).

81. **Corvus Americanus** Aud. Common Crow.

Common throughout the New England States. Partially migrant.

82. **Cyanura cristata** Sw. Blue Jay.

Common and resident throughout New England.

83. **Perisoreus Canadensis** Bonap. Canada Jay. "Meat Hawk."

Two specimens were taken early in June, 1870, by Messrs. Deane and Bailey, at Umbagog. May breed, but this is south of its usual summer range. I found it common at Errol, November 3d, 1869. I also took two a little later in the season at Bethel. Common during winter at Norway (Verrill). This bird has a variety of harsh, discordant notes, some of which resemble the sounds produced by the common *Lynx rufus.* It is quite inquisitive, and will follow the traveler through the woods for miles, keeping quite near him.

## TYRANNIDÆ.

84. **Tyrannus Carolinensis** Baird. King Bird.

Common throughout New England States and Canada. Breeds. Winters in the West Indies.

85. **Myiarchus crinitus** Cab. Great-crested Fly-catcher.

Given by Verrill as rare at Norway. Common summer resident at Hamilton (McIlwraith). Massachusetts is its northern limit on the eastern coast, but stragglers sometimes go further north. Winters in southern Florida and Central America.

86. **Sayornis fuscus** Baird. Bridge Pewee.

Common at Norway (Verrill), during the breeding season. Not given at Quebec (Couper). I think it does not range much north of this part. A widely distributed species. Winters in immense numbers in Florida.

87. **Contopus borealis** Baird. Olive-sided Fly-catcher.

Quite common and breeding at Umbagog. Not found at Franconia, though common at Gorham (Brewster). Rare at Norway (Verrill). Not given at Quebec (Couper), or at Hamilton (McIlwraith). I am not certain whether this species has a higher northern distribution or not, but judge that it may be found as far north as the barren grounds. Is not known to breed south of Massachusetts. I think this species winters in Mexico and Central America. It has the habit of perching on dead stubs on the edge of clearings at Umbagog, and giving its loud, clear notes. Mr. Brewster observed this same peculiarity at Gorham.

88. **Contopus virens** Cab. Wood-Pewee.

Common throughout the New England States, but perhaps less so in the northern section. Given by Couper as breeding rarely at Quebec. This is beyond its usual range, however. A widely distributed species. Winters in Central America and Mexico.

89. **Empidonax minimus** Baird. Least Fly-catcher.

Common throughout New England. Breeds. Not given by Couper at Quebec. Probably winters in Central America.

90. **Empidonax Traillii** Baird. Traill's Fly-catcher.

Common at Gorham (Brewster), and at Quebec (Couper). Breeds. Not common at Norway (Verrill). Rare in summer at Hamilton (McIlwraith). Did not see it at Umbagog, but shot two specimens in an alder thicket, by the side of a stream at Newry. This species has a most peculiar note like the syllables *Ke wink*;

this is not so quickly given as the *se wick'* of *E. minimus*, and is somewhat harsher. There is, perhaps, thirty seconds interval between each *ke wink'*. The birds while singing were perched on the tops of a low alder. It appears to frequent these thickets generally by the side of streams, for Mr. Brewster has repeatedly observed it in similar localities at Gorham, where it has the same song and habits. When the bird is freshly killed, the bill bears a striking resemblance to that of *E. flaviventris*, being somewhat broader than *E. minimus*, and having a yellow under mandible delicately veined with purple. But in the dried skin, this yellow fades into brown and loses its veining. The whole bird then appears much like the larger and darker types of *E. minimus*. Indeed, were it not for the slightly larger and broader bill, generally olivaceous, or greenish yellow of the strip at the base of the upper mandible and sides of the head of *E. Traillii*, it would be difficult to determine skins of the two species. Although these species approach each other so closely that without a sufficient number of skins for comparisons, they are in great danger of being confounded, two intermediate species have been formed, *Acadicus* and *pusillus*. The only difference between *Traillii* and the former, are the feathers on the crown of *Acadicus* lack the darker centres of those of *Traillii* and a few other (seemingly to me), inconsistent characters. The latter (*pusillus*) is also described as quite like *Traillii*, but different from it in being browner, and having a less amount of white on the wings, with a few other characters that I have repeatedly proved (to my mind), to be exceedingly variable and inconstant. Although I have never seen a sufficiently large series of these three species (*pusillus*, *Traillii* and *acadicus*), to prove conclusively that they are one, I have seen enough to cause grave doubts in my mind, as to the validity of the characters used in separating them. Indeed, I have been unable to find any decided difference between the specimens of *pusillus* and *Acadicus*, labelled by competent authorities, that I have examined and compared with quite a large series of *Traillii* taken north.

In connection with these observations, which have induced me to advance the hypothesis that these three so-called species are one, I have been strengthened in my opinions by the experience gained by studying the individual variations of birds. One of the first and simplest lessons we can learn in this study, is that such characters as intensity and paleness of color are subject to wide individual differences, and should be used with extreme caution in determining spe-

cies. This is especially noticeable in the Fly-catchers, specimens from the south being very much browner than those taken north. In making these observations, the student will also perceive that species having stripes or spots caused by dark centres of the feathers, are subject to wide individual variations in this respect. In specimens with generally pale colors[1] the lighter margin of the spotted feathers will be wider, and if the central stripes are narrow or the spots small, the entire feathers will become of a uniform color, or with a shade or two darker nearer the base. In darker colored individuals the reverse is the case, the darker spots become larger and increase in number. This is particularly to be remarked in the genera of Turdus, Myiarchus and Empidonax.

Again, in pale specimens all white markings, such as bars on the wings, terminal spots on the quills or tail feathers, generally increase in size and width, while in the darker types these spots and bars will decrease and sometimes disappear entirely.

Another character which is considered of specific value in comparing these supposed species, is the number of the longest quill and its comparative length. To show how inconstant this is, we have but to examine a series of any of the Fly-catchers. Take for example *E. minimus*, and of 23 specimens examined, 12 have the third quill the longest, 3 the second, 7 the second and third, while one has the fourth.

Understanding, then, the slight, though constant, difference between *minimus* and *Traillii*, it seems to me that, with the individual variations to which these species are subject, it is impossible to form a *single* species between them with constant characters not possessed by either one or the other, but when *two* are brought forward, and characters sought after that are strictly specific, dividing each from the other, and both from *Traillii* and *minimus*, the subject becomes very much confused, and exceedingly difficult to comprehend.

91. **Empidonax flaviventris** Baird. Yellow-bellied Fly-catcher.

"Common at Franconia, where it breeds. I have seen the young out of the nest by August 1st. When the young were approached the female uttered the usual *pea* as a note of distress, but more plaintively than at other times. Frequents the maple undergrowth in the mountain ranges" (Brewster). Not uncommon at Umbagog. Prob-

[1] Represented in dark brown colors by a bright rufus, in rufus by buff, in dark olive or brownish green by brighter greens, or more olivaceous.

ably breeds rarely at Hamilton (McIlwraith) and Norway (Verrill). We found it in dark swamps at Upton. Here, for the first time, I detected this species with any other note than the low *pea*. It was like the syllable *kil-lic* very gravely given, with a long interval between each utterance. The song was even less energetic than that of *Traillii*. While singing, the birds were perched on low limbs. Both male and female used this note. Both of the latter species winter in South America.

## ALCEDINIDÆ.

92. **Ceryle alcyon** Boie. Belted Kingfisher.

Common throughout New England. This species has a wide distribution. Winters in the Southern States. "Occurs high up on the mountain sides at Gorham, and is looked upon as a nuisance by the trout fishermen" (Brewster).

## CARPRIMULGIDÆ.

93. **Antrostomus vociferus** Boie. Whip-poor-will.

Common in summer throughout New England. Arrives at Upton about June 1st. Winters in Florida and the West Indies.

94. **Chordeiles popetue** Bd. Night Hawk.

Common throughout New England. A large number of females came for several successive nights during the second week in June, and alighted on a small piece of cultivated ground near the hotel at Upton. Several that were shot contained eggs about to be laid. They must have been gathering the fresh earth, as they were walking about on the ground, apparently searching for something. This bird winters in the West Indies.

## CYPSELIDÆ.

95. **Chætura pelasgia** Steph. Chimney Swift.

Common throughout New England. "Saw them nearly every day in summer flying through the notch at Gorham. Thirty miles down the valley, at Plymouth, they had a roost in an old chimney, to which they came pouring in every evening from all directions, until thousands had collected" (Brewster). This species winters far south.

## TROCHILIDÆ.

96. **Trochilus colubris** Linn. Ruby-throated Humming Bird.

Common throughout New England. Winters in large numbers in Key West and the West Indies.

## CUCULIDÆ.

97. **Coccygus erythrophthalmus** Bon. Black-billed Cuckoo.

Common at Norway (Verrill). I think only stragglers ever go north of the White Mountain range. Saw a single specimen at Upton, June 5th, 1871. Mr. Brewster saw another at Gorham in summer.

98. **Coccygus Americanus** Bon. Yellow-bellied Cuckoo.

Rare at Norway. Not seen at Upton, Franconia, or Gorham (Brewster). This species probably finds its northern limit at the same point as the preceding. Both species winter in South America.

## PICIDÆ.

99. **Picus villosus** Linn. Hairy Woodpecker.

Very common resident. Breeds.

100. **Picus pubescens** Linn. Downy Woodpecker.

Less common resident than the preceding. Breeds.

101. **Picoides arcticus** Gray. Black-backed Three-toed Woodpecker.

Common in winter at Norway (Verrill).

102. **Picoides hirsutus** Gray. Banded Three-toed Woodpecker.

Not given by Verrill at Norway. Rare at Calais (Boardman). Mr. Brewster took two adult males at Gorham, July 30th, 1870, and one at Umbagog the first week in June, 1871. I took a single specimen at Errol, October 31st, 1869. This species has a harsh, discordant note.

103. **Sphyrapicus varius** Baird. Yellow-bellied Woodpecker.

Common throughout this northern section in summer. Breeds about Umbagog about the second week in June. It utters a peculiar alarm note which closely resembles that of the blue jay. Mr. Brewster in describing its habits at Gorham, says: "It commonly feeds on a species of large yellow hornets, that punctures the bark of

the birch tree with rows of square holes. It also had the habit of sitting on the top of some dead stub and darting at insects, then retreating to its perch like a fly-catcher." Winters in the Southern States and Florida.

**104. Hylatomus pileatus** Baird. Pileated Woodpecker.

Not uncommon resident in this section of New England. Breeds.

**105. Melanerpes erythrocephalus** Sw. Red-headed Woodpecker.

Rare at Albany in summer.

**106. Colaptes auratus** Sw. Golden-winged Woodpecker.

Common, and breeding throughout New England. Resident in the more southern section.

## STRIGIDÆ.

**107. Bubo Virginianus** Bon. Great Horned Owl.

Common resident throughout New England.

**108. Scops asio** Bon. Mottled Owl.

Common resident throughout New England.

**109. Otus Wilsonianus** Aud. Long-eared Owl.

Common, and resident throughout New England. The short-eared owl is undoubtedly found here, but it is not given by Verrill at Norway. I never saw it in this section. Common at Hamilton (McIlwraith), and at Quebec (Couper).

**110. Syrnium cinereum** Aud. Great Gray Owl.

Rare in winter at Norway (Verrill).

**111. Syrnium nebulosum** Gray. Barred Owl.

Common resident throughout New England.

**112. Nyctale Acadica** Bon. Acadian Owl.

Common resident throughout New England.

**113. Nyctea nivea** Gray. Snowy Owl.

Not very common at Norway (Verrill).

**114. Surnia ulula** Bon. Hawk Owl.

Common autumn and winter at Norway (Verrill].

## FALCONIDÆ.

**115. Falco anatum** Bon. Duck Hawk.

At Norway spring and fall (Verrill).

**116. Hypotriorchis columbarius** Gm. Pigeon Hawk.

Spring and fall.

**117. Falco sacer** Forster. Jerfalcon.

I saw a single specimen Nov. 5th, at Errol.

**118. Tinnunculus sparverius** Vieill. Sparrow Hawk.

Spring and fall, not very common at Norway (Verrill).

**119. Astur atricapillus** Bon. Goshawk.

Common resident in northern New England.

**120. Accipiter Cooperi** Bon. Cooper's Hawk.

Common at Franconia and Gorham in summer (Brewster.) Not common summer visitor at Norway (Verrill).

**121. Accipiter fuscus** Bon. Sharp-shinned Hawk.

Common summer visitant at Norway (Verrill).

**122. Buteo borealis** Vieill. Red-tailed Buzzard.

Common summer visitant in northern New England. Resident in the southern section.

**123. Buteo lineatus** Jard. Red-shouldered Buzzard.

Common summer visitant to northern New England. Resident in the southern sections.

**124. Buteo Pennsylvanicus** Bon. Broad-winged Buzzard.

Common summer visitant in northern New England.

**125. Archibuteo lagopus** Gray. Black Hawk.

Common in the adult black plumage (*A. sancti-johannis* of authors) at Norway in winter (Verrill).

**126. Circus Hudsonius** Vieill. Marsh Hawk.

Common summer visitant at Norway (Verrill).

**127. Pandion Carolinensis** Bon. Fish Hawk.

Not very common throughout New England. "Breeds at Umbagog about the first of June" (Deane).

**128. Aquila Canadensis** Cass. Golden Eagle.

"A pair have bred for years on the cliff directly over the Profile House. They could be seen at almost any hour of the day scaling about their eyrie, uttering loud screams, but were especially noisy and active from sunset to dark" (Brewster).

**129. Haliaëus leucocephalus** Savig. Bald Eagle.

Common resident throughout northern New England.

## COLUMBIDÆ.

**130. Ectopistes migratorius** Swain. Wild Pigeon.

Common in summer throughout the wilder section of New England.

## TETRAONIDÆ.

**131. Tetrao Canadensis** Linn. Spruce Partridge.

Common at Umbagog. The White Mountain range seems to form its southern limit. "Is found in secluded, swampy localities. The eggs were taken in the latter part of May by J. G. Rick, found young on June 15th" (Deane.)

**132. Bonasa umbellus** Steph. Ruffed Grouse. "Partridge."

Common resident throughout New England.

## CHARADRIIDÆ.

**133. Charadrius Virginicus** Borck. Golden Plover.

Common in autumn at Norway (Verrill).

## SCOLOPACIDÆ.

**134. Philohela minor** Gray. Woodcock.

Not a common summer resident. A nest with four eggs was found by Rich, near Lake Umbagog, May 10th, 1870.

**135. Actodromus maculata** Cass. Jacksnipe.

Not common in autumn at Norway (Verrill).

**136. Gambetta melanoleuca** Bon. Tell-tale. Greater Yellow-Legs.

Not a common summer visitor.

**137. Gambetta flavipes** Bon.

Not a common summer visitor at Umbagog, and Norway (Verrill.)

**138. Rhyacophilus solitarius** Baird. Solitary Sandpiper.

Not common at Umbagog, or at Norway (Verrill). "Common in July at Gorham when they were migratory; saw a pair with young in August at Franconia" (Brewster). I took a specimen in Errol, November 1st, 1869, when the ground was covered with snow and the ponds were partly frozen.

**139. Tringoides macularius** Gray.

Common through New England in summer. Breeds at Umbagog about June 6th.

**140. Actiturus Bartramius** Bon. Field Plover.

Common summer visitant. Breeds at Norway (Verrill).

## ARDEIDÆ.

**141. Ardea herodias** Linn. Great Blue Heron.

Common and breeds throughout northern New England.

**142. Botaurus lentiginosus** Steph. American Bittern.

Common, throughout New England. Breeds at Umbagog about June 5th. Builds nests of sticks which are placed on the ground of the floating islands on the Lake; lays six eggs.

## RALLIDÆ.

**143. Porzana Carolina** Vieill. Carolina Rail.

Not a common summer visitant at Norway (Verrill).

## ANATIDÆ.

**144. Bernicla Canadensis** Boie. Canada Goose.

Common during the migrations throughout northern New England.

**145. Bernicla brenta** Steph. Brant.

Like the preceding, common during the migrations.

**146. Anas boschas** Linn. Mallard.

Rare spring and fall at Norway (Verrill).

**147. Anas obscura** Gm. Black Duck.

Summer visitant to northern New England. Breeds commonly about Umbagog.

**148. Querquedula discors** Steph. Blue-winged Teal.

Common spring and fall.

**149. Aix sponsa** Boie. Wood Duck.

Common summer visitant, and breeding throughout the wilder portions of New England. Breeds at Umbagog about May 15th. Saw young a week old June 7th.

**150. Fulix affinis** Baird. Scaup Duck.

Not common during the migrations (Verrill).

**151. Fulix collaris** Baird. Ring-necked Duck.

Not common spring and fall (Verrill).

**152. Aythya Americana** Bon. Red-head.

Rare, spring and fall (Verrill).

**153. Bucephala Americana** Baird. Whistler.

Breeds at Lake Umbagog. "One nest containing eight eggs was found in a tall stub." (Deane.) I have seen it in November on the Lake.

**154. Bucephla albeola** Baird. Ruffle-head.

Common, spring and fall (Verrill).

**155. Harelda glacialis** Leach. Old Squaw.

Not common spring and fall (Verrill).

156. **Pelionetta perspicillata** Kaup. Surf Duck.

Rare spring and fall (Verrill).

157. **Mergus Americanus** Cass. Sheldrake.

Common spring and fall (Verrill). I have seen it on Lake Umbagog, in November.

158. **Mergus Serrator** Linn. Red-breasted Merganser.

Not common spring and fall.

159. **Lophodytes cucullatus** Reich. Hooded Merganser.

Breeds not uncommonly on Lake Umbagog in hollow stubs, according to J. G. Rich. Mr. Deane has the eggs taken there.

LARIDÆ.

160. **Larus argentatus** Brunn. Herring Gull.

Breeds on some rocks in B Pond every season about June 5th, (Deane).

161. **Chrœcocephalus Philadelphia** Leach. Bonaparte's Gull.

Not common spring and fall (Verrill).

COLYMBIDÆ.

162. **Colymbus torquatus** Brunn. Loon. Common about the lakes and ponds. Breeds at Umbagog about June 15th.

PODICIPIDÆ.

163. **Podiceps cornutus** Lath. Horned Grebe.

Rare spring and fall (Verrill).

164. **Podilymbus podiceps** Lawr. Water Witch. Common spring and fall (Verrill).

Prof. Agassiz made some observations on a set of boulders in Berkshire County, Mass.

These boulders are found in place only upon a ridge in Canaan, from which some have been carried by glacial action and deposited in parallel lines through Richmond and Lenox, crossing two ranges of hills in their course. These boulders could not have been distributed in this regular manner by

icebergs. They are rounded and scratched and must have been carried beneath the glacier. Similar lines of boulders in New England always extend in the direction of the ice scratches on the rocks. He thought this evidence settled the iceberg theory, and that Dr. Reed, of Canaan, had not received due credit for his observations on this subject.

Prof. Shaler stated that the boulders in Ohio, Kentucky and the vicinity of Lake Erie, must have been carried over two hundred miles from Crestline Ridge, north of Lake Erie.

Prof. Agassiz stated that the glacial scratches run obliquely across the Berkshire and Wachusett ranges and trend to the Atlantic, which he thought indicated the former existence of an immense ice-sheet rather than a local Connecticut Valley glacier. This ice sheet, he thought, was not less than ten thousand or twelve thousand feet in thickness. He had traced the glacial marks on the Rocky Mountains to a height of eleven thousand feet, and thought these mountains must have been covered by the ice as well as the New England hills.

Dr. Chas. T. Jackson remarked in relation to the distance to which boulders had been transported, that rocks containing peculiar andalusite macle had been carried from the White Mountains to the Atlantic, and stone walls were built of them in South Berwick, Me. Boulders also had been transported from Kingston, R. I., to the top of Block Island.

Prof. Agassiz thought that this latter case might be explained by the sea having encroached on the land, since the boulders were deposited on what is now Block Island.

Mr. F. W. Putnam called the attention of the Society to the destruction of the Museum of the Chicago Academy of Sciences, by the great fire, and proposed the following resolu-

tion, which was seconded by Prof. Agassiz and unanimously adopted :—

*Resolved:* That the Boston Society of Natural History, having received information of the destruction of the Collections, Library and Building of the Chicago Academy of Sciences during the recent devastating fire, hereby offers its sympathy to the Academy in this, its second trial by fire, with the promise of a series of its publications, and such duplicate specimens as may prove acceptable, when the Academy is prepared to receive them.

The thanks of the Society were voted to Mr. John J. Glover, for a fine mounted specimen of the male peacock, *Pavo cristatus*.

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## Section of Entomology. October 25, 1871.

Mr. P. P. Mann in the chair. Thirteen persons present.

Dr. H. A. Hagen read the following communication:—

I wish to bring to your notice at this meeting a new kind of pocket lens made by Carl Zeiss, of Jena, Germany, at a very low price, and used and strongly recommended by Hæckel and other naturalists. I have imported two sets, and examined three other sets just imported by others. The definition of these lenses is perfectly good and their great focal distance permits one to work very easily. They are made on the plan of Brück's lens, having a concave eye lens adapted to the objectives. The following table shows their magnifying power, focal distance and diameter of field, which is very large :

| *Magnifying power.* | *Focal distance.* | *Diameter of field.* |
|---|---|---|
| 8 diameters | $4\frac{1}{2}$ inches | .60 inches. |
| 18 " | $2\frac{5}{16}$ " | .18 " |
| 36 " | $1\frac{3}{16}$ " | |
| 72 " | 1 " | .08 " |
| 120 } 180 } " | $\frac{3}{4}$ " | .08 " |

The prices are 3 thalers for the 4 1-2 inch, 7 thalers for the 2 3-10 and the 1 2-10 together. The others, together with a complete stand, 21 thalers. An achromatic pocket lens made on a new plan and magnifying 12 diameters, with 9-10 of an inch focal distance and 1-2 inch field is furnished for 3 thalers.

Mr. P. S. Sprague announced that he had raised a hymenopterous parasite from the pupa of *Pieris rapæ*, which Dr. Packard had identified as *Pteromalus puparum* of Europe.

Dr. Hagen presented to the Society a specimen of the wingless *Bittacus apterus* Mc Lach., discovered in San Jose, Cal., by Mr. Wm. Holden, and described in the *Entomologist's Monthly Magazine* for October, 1871. Dr. Hagen stated that Mr. Holden had found a wingless Tipula in the same region which bears a striking resemblance to the Bittacus.

Mr. F. G. Sanborn reported the recent capture of a spider, of the genus Lycosa?, upon which was a parasitic larva apparently dipterous.

Dr. Hagen remarked that two species of Hymenoptera were known to be parasitic on spiders in Europe, but this was the first account of a dipterous parasite on these animals.

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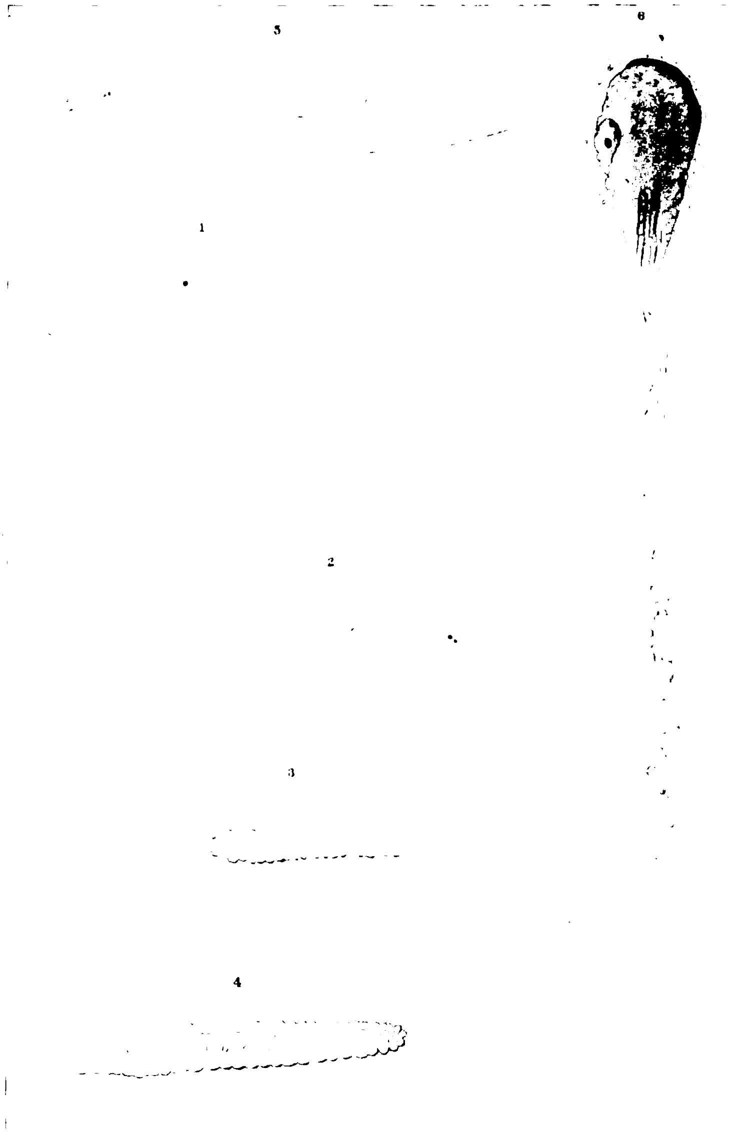
November 1, 1871.

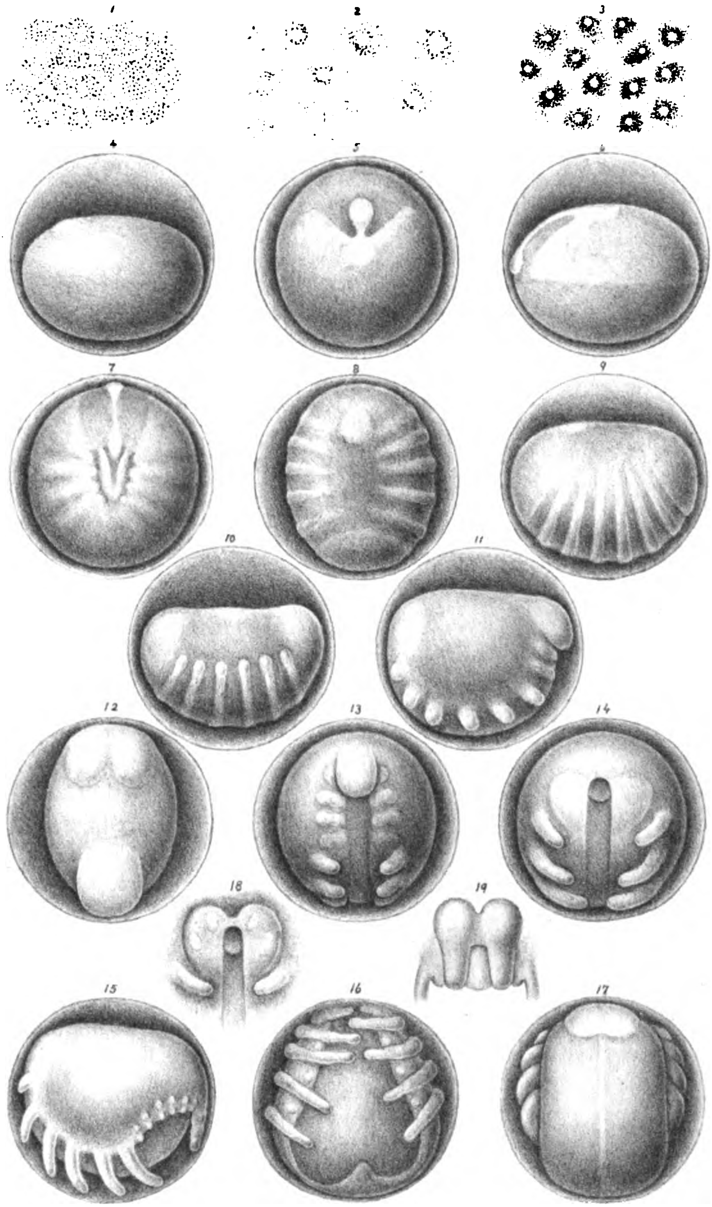
The President in the chair. Twenty-nine persons present.

The President offered the following tribute to the late Secretary of the Society, Rev. J. A. Swan, who died October 31, 1871.

I know not how to utter the deep grief I feel and which I know is shared by you all, in the death of our dear companion, Mr. Swan, the Secretary of this Society. No one I




MORSE, ON EARLY STAGES OF AN ASCIDIAN

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EMERTON, DEVELOPMENT OF PHOLCUS.

am sure who has had the pleasure of personal intercourse with him, but will feel that he has lost a near and dear friend.

To me his presence even, has always seemed a benediction. I do not think I ever was so much impressed by the personal character of any man with whom I have come in contact, as with that of Mr. Swan. He seemed always overflowing with love for, and a desire to aid, all about him. What might excite in other men feelings of bitterness or anger, moved him only to sorrow, and no one was more charitable in his judgments of the acts of others. Truly we have lost from our circle a man devoid of guile, upright in conduct, loveable beyond expression, pure in heart and faithful in every duty. God grant that his family, so dear to him, may have strength to bear the loss that falls so much more heavily upon them than upon all others.

Prof. J. D. Runkle offered the following resolutions:

*Resolved:* That in the death of Mr. Swan, the Society recognize the loss of not only a highly efficient officer and member, but of an associate greatly respected for his attainments as a scholar, admired for his noble qualities as a gentleman, and loved for his many virtues as a man and a Christian.

*Resolved:* That a Committee be appointed to prepare a sketch of his life for the Proceedings.

*Resolved:* That the action of this meeting be communicated to the family of the deceased.

In accordance with the second resolution, the President appointed a Committee consisting of Dr. Jeffries Wyman, Rev. E. C. Bolles, and Mr. W. T. Brigham. Out of respect for the occasion, it was then moved that the Society adjourn; but the President announced that Prof. Agassiz, who was present, had prepared a communication for the present meeting, and expected to depart immediately on a long voyage, and the motion was withdrawn.

Prof. Agassiz then made an exposition of the relations between certain extinct genera of fishes, bringing forward strong evidence that the Chimæroids, Skates and Sharks form three groups nearly equal in value. Prof. Agassiz also read a letter from Dr. Anton Dohrn, of Jena, who writes that the project which has long occupied the attention of zoologists, namely, to establish a Laboratory of Marine Zoology on the Mediterranean, is on the point of being realized. Dr. Dohrn is authorized to construct at his own expense, and have the control of, for not less than thirty years, a building in the Villa Reale, in Naples, close to the sea, containing an aquarium for the public, and extensive workrooms for naturalists of every country. Dr. Dohrn, with other German zoologists, proposes to settle there and take charge of the station. Helmholtz, Dubois Reymond, Huxley, Darwin, Hæckel, Leuckart, Van Beneden, Agassiz, and others have consented to form a committee to aid the project.

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November 15, 1871.

The President in the chair. Twenty-three persons present.

The President read the following letter:

"Mr. R. M. Hodges, in behalf of his daughter, Mrs. J. A Swan, her family and other relations, presents to the President, his associates in office, and to the members of the Boston Society of Natural History, his grateful acknowledgements for their interest in the Rev. Joshua Augustus Swan, while he was connected with the Society, and for the deep and tender respect in which they hold his memory since his decease. The tie which has been severed by his death, has wounded many hearts that were favored with his sympathy and love in the activities and affinities of life.

*Cambridge, Nov. 11, 1871.*"

Prof. Morse made some remarks on the Relationships of Amphioxus.

Prof. Morse also made some remarks on the bones of the carpus and tarsus in birds and reptiles.

Dr. Thomas Dwight remarked on a peculiar nerve plexus, which he had noticed in the upper lip of *Phoca vitulina*, the harbor seal.

The fifth pair of nerves is extremely large and breaks into fibres, some going to the root of the whiskers, and others beyond, but one set formed a loop following down the sensory filaments nearly to the roots of the hair, then recurving accompany the motor filaments which pass down from the facial nerves. He could find no account of this structure in works on the subject, and was unable to say whether it was the usual or exceptional condition.

Prof. Morse gave some observations of his on a species of "frog-hopper" or "spittle insect."

It has been stated that these insects excrete their frothy covering, but they, in fact, excrete a perfectly clear liquid and add the bubble afterwards. When placed in the middle of a drop of clear fluid the little insect immediately backs to the margin, and protruding the caudal appendages, grasps a bubble of air and draws back into the drop. The air thus obtained runs along the concave ventral surface of the abdomen, where it can be noticed shining like little quicksilver globules. This air supplies the abdominal spiracles, and when it becomes no longer fit to breathe, is allowed to escape into the fluid. The insect then proceeds to take another bubble of air and this process is repeated until the originally clear drop is blown up into a frothy mass, forming an effective retreat for its inhabitant.

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## Section of Entomology. November 22, 1871.

Mr. S. Henshaw in the chair. Ten members present.

Mr. James Boll exhibited specimens of Ploiaria and Emesa captured in stables in Cambridge.

Dr. Hagen exhibited the eggs of *Ploiaria brevipennis*, which are of an elongated, conical form.

Mr. C. S. Minot stated that the potato crop in some parts of Maine had been much injured during the past summer by the attacks of *Capsus quadrivittatus*, which, puncturing the leaves, induced decay.

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December 6, 1871.

The President in the chair. Forty-three persons present.

Prof. Chas. H. Hitchcock made some remarks in regard to his recent survey of the Ammonoosuc gold fields, and promised a more detailed communication at a future meeting.

Dr. Chas. T. Jackson said that when engaged in the survey of New Hampshire, he had never found Labrador feldspar *in situ*. The more he thought of the andalusite macles in Sterling and Lancaster, the more he became convinced that they were not in place, but had been brought a long distance.

Prof. Hitchcock said, in answer to a question from Dr. Jackson, that he had found fossils in Littleton, but nowhere else in the White Mountains. In this place a large number of corals had been found, but no other fossils. These corresponded with those of the Helderberg rocks on Lake Memphremagog.

Prof. Shaler made some remarks on the rattlesnake and Natural Selection,[1] showing that the note of the rattlesnake closely resembles that of the Cicada, and thus seems to decoy insectivorous animals. The rattle is, therefore, useful to the snake and cannot be used as an argument against Mr. Darwin's theory.

A discussion on this subject followed, participated in by Messrs. Hitchcock, Farlow, Tuttle, Hyatt, and others.

[1] See American Naturalist, Vol. vi, p. 32.

## Section of Microscopy. December 18, 1871.

**Mr. Edwin Bicknell in the chair. Twelve members present.**

The Chairman exhibited a new binocular instrument by Zentmayer, intermediate in size between the "grand" and "hospital" stands. He stated that for some months he had been using a Tolles binocular eye-piece and a fine Wenham binocular made by Zentmayer, and had carefully compared their performance. He found the Wenham best with objectives of from 3 inches to ½ inch focal distance, and the Tolles the best with ⅘ to $\frac{1}{10}$ objectives, and in stereoscopic effect, the Tolles eye-piece far exceeds the Wenham arrangement.

Mr. A. H. Tuttle read a paper on a species of the genus Uvella, Ehrenberg, a compound flagellate infusorian.

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## December 20, 1871.

The President in the chair. Twenty-five persons present.

The following paper was read: —

### Observations on the Development of Pholcus. By James H. Emerton. Plate II.

The spiders, from which the eggs were taken on which these observations were made, agree with the descriptions of *Pholcus phalangioides* Walck, and with the figure of that spider in Blackwall's spiders of Great Britain and Ireland. They are very common about Salem in cellars and dark buildings, but I have never seen one far from houses. The embryology of this species has been studied by Claparède and forms the principal part of his memoir on the development of spiders.[1]

In July, 1871, several females were confined in glass cases and be-

[1] Recherches sur l'evolution des Araignées. Utrecht, 1862.

tween July 28th and Aug. 3d, laid their eggs and were found carrying them bound together in a mass in the usual manner.

In eggs examined within four hours after they were laid, the vitellus was spherical and its surface covered with polygonal cells (Pl. II. Fig. 1) filled uniformly with granules but showing no nuclei. Cells with transparent nuclei soon appeared here and there (Fig. 2), and within twenty-four hours covered the whole surface of the vitellus, (Fig. 3), which had meanwhile diminished in size and become somewhat flattened (Fig. 4). One half was whiter and more opaque than the other, and always turned upward, in whatever position the egg might be placed.

On the second day (July 31), a distinct white spot appeared a little way from the centre of the upper side of the vitellus and slightly elevated above its surface, the *cumulus primatif* of Claparède (Fig. 4). From this extended a pear-shaped appendage which, at 4 P. M., Aug. 1, reached to the margin of the opaque upper half of the vitellus. (Figs. 5 and 6). At the same time, beginning at the cumulus, the whole surface became whiter except a strip on each side of the pear-shaped appendage (Figs. 5 and 6). When the latter had reached its full length its peduncle gradually became narrower and finally disappeared entirely, while the central portion of the cumulus became divided lengthwise by a transparent band, which widened toward the point where the appendage began (Fig. 7).

At 7 P. M., Aug. 1, the first traces of the segments of the body appeared (Fig. 7) as four white stripes extending from the cumulus on each side and finally meeting on the ventral surface, where two more segments, one at each end, could be distinguished. These six segments, which at first nearly encircled the embryo (Figs. 8 and 9), gradually separated on the dorsal surface until they extended only half round it at 7 P. M., Aug. 2, and at the ends of each segment appeared the rudiments of limbs which continued to approach toward the ventral portion of the embryo (Fig. 10). At this stage the whole embryo was barrel-shaped, and the head and abdomen were indicated only by undefined whiter portions at each end (Fig 10).

Aug. 3 the whole body became shorter and the limbs were about half the diameter of the egg apart on the ventral side. The head was distinctly outlined and the post-abdomen projected from the opposite end of the body (Figs. 11 and 12). Two segments of the abdomen had formed between the thoracic segments and the post-abdomen. At this stage first appeared a transparent band extending

from the anterior part of the head along the ventral surface to the post-abdomen, dividing the whole embryo into two parts (Figs. 13 and 14).

Aug. 4 the segments of the abdomen increased in number from two to six, and the post-abdomen became narrowed and constricted into three divisions and turned down against the abdomen (Fig. 15). Each segment of the abdomen now showed two pairs of appendages, the *bourrellets ventraux* of Claparède, one pair on the edges of the transparent band, the other a little removed from it in line with the legs. Twelve hours later, when the separation of the ventral portion had exposed the under side of the body, between the legs a pair of similar appendages could be seen on each segment of the thorax, on the edges of the transparent band (Fig. 16).

Aug. 5 the turning of the embryo began. The transparent ventral band had widened at the posterior part of the thorax to nearly the diameter of the body. The post-abdomen had turned down along the ventral surface of the abdomen. The thoracic portion now diminished in size while the abdominal portion increased, turning gradually under the thorax between the legs. At this stage the under lip appeared in the anterior end of the transparent band, which now reached to the top of the head (Fig. 18), but in the next three days descended below the mandibles (Fig. 19). The position of the eyes was indicated by two pairs of white spots (Fig. 18) on the front of the head, and of the dorsal vessel by a white line from the head to the front part of the abdomen (Fig. 17).

Aug. 6 the thorax continued to diminish and a constriction began between it and the abdomen.

Aug. 10 the eyes were distinctly seen, and the mandibles had come together in front of the mouth. The legs entirely covered the ventral surface of the body.

Aug. 11 the eggs began to hatch, the outer envelope cracking along the lines of the limbs and not coming off entirely for two days. The first moult took place Aug. 16.

Mr. B. P. Mann read portions of an account of the "White Coffee-leaf miner", *Cemiostoma coffeellum*, which he had prepared for the *American Naturalist*.

Mr. W. T. Brigham called attention to a mounted specimen of the mute swan, *Cygnus olor*, presented by the Hon.

Arthur N. Austin, and upon his motion a vote of thanks for the gift was passed.

Prof. Hyatt spoke of the results of his researches on the embyology and development of the Shells of the Ammonoids and Nautiloids, made at the Museum of Comparative Zoology in Cambridge.

The ovisac of Ammonites was discovered by Louis Sacmann and figured in Dunkee and Meyer's Paleontographica. A figure of *Nautilus aratus* was also drawn alongside of this in order to show the contrast of its obtusely pointed apex with the globular apex of the first whorls of *Lytoceras fimbriatus*.

Other authors before this had regarded the Goniatites as the only forms of tetrabranchiate Cephalopods which possess globular ovisacs, and had characterized the young in this way. I have been able to verify Sacmann's observations with his original specimens, so that we must now consider all the Ammonoids as beginning with a globular ovishell.

Nautilus, also, though it never retains an ovisac, shows at the apex a scar which marks the former attachment of some such embryonic shell. This scar has such a form that one is led immediately to compare it with the outline of the aperture and living chamber of Gomphoceras.

The aperture of the embryo and the form of the living chamber, as indicated by the scar, has its longest axis vertical or abdomino-dorsal instead of from side to side, as in many Goniatites and all of the typical Ammonites.

No signs of this scar were directly observed among fossil Nautiloids, though indications of its presence were not wholly wanting, especially among Jurassic Nautili.

The variability in the form of the young and its amount of coiling is much greater in the earlier than in the later formations. Among Silurian species the young may be straight like Endoceras, and as the siphon is probably central at this age and composed as in Endoceras of a succession of siphonal funnels, we must have with this agreement of form an agreement of structure also. These straight young form the nuclei of varieties with elliptical adults, and the passage is insensible from these to others of the same species having young which are closely coiled from the very beginning.

In the Devonian among the young of Goniatites the variation of the young is not so great, and according to Sandberger's observation the amount of coiling is at least of specific value.

In the Jura the young do not vary among the typical Ammonites, all are closely coiled and all are involute.

The straight young of the Silurian *Goniatites Bohemicus* are evidently reversions to the ancestral type of Endoceras, and show the tendency of the organization to revert to that type whenever the growth is retarded; whereas the closely coiled varieties of the same species show the progressive tendency of the series, which is expressed more determinately among the Goniatites of the Devonian, and finally becomes universal among the typical Ammonities of the Jura. The first septa of Ammonites and Goniatites closely resemble each other; and also those of the adult Nautiloids; both have large, simple, entire abdominal cells, and broad, simple, superior lateral lobes. The form of the first whorl among the Ammonites is like that of a typical adult Goniatite, but the septa cannot be so closely compared.

The siphon is very similar in both forms. It is a blind sac, at first opening at the middle through the first septum. The second septum embraces the narrowing neck, from which springs the slender tube of the siphon proper. Every successive part between the different septa is formed by a posterior inflection or bending of the septa themselves. Thus the fundus of the siphon is composed of a cœcal prolongation of the first septum; this is the lower part of the siphonal cœcum or bag. The next segment is formed by a corresponding elongation of the second septum, which, however, is open at the bottom, and continues the walls of the blind sac; the next, a third septum, sends down another prolongation, which is very narrow comparatively, and forms the neck of the siphonal cœcum or the siphon proper. The differences of Ammonites and Goniatites are to be found in the conical prolongation of the siphonal cœcum. This organ is a cone-like posterior extension of the cœcum, which opens into the bottom of the siphonal cœcum in Goniatites, but is closed over by the bottom of the cœcum in Ammonites.

The second septum of Goniatites is like those of the adult Nautilini of the Silurian; the third has a pointed goniatitic superior lateral lobe. The Ammonite has the second septum more ammonitic than goniatitic on account of the broad superior lateral and abdominal lobes. There is here a decided acceleration, since the true goniatitic characteristics are hardly visible except in the form, whereas in Gon-

iatites there is a repetition of the characteristics of the Nautilini in the second septum and the pure Goniatite does not appear until the third septum.

Among the Nautiloids the same formation of the siphon is found, but the cœcum is entirely out of the embryonic ovi-shell, which has left the cœcum entirely isolated inside of the apex of the first whorl. The first septum of the recent Nautilus has a faint ventral cell, is very shallow, not parallel with the area of cicatrix, and is penetrated by a dorsal lobe.

The first septum of *Nautilus atratus* of the Jura is very shallow, nearly parallel with the area of the scar,[1] and not penetrated by a dorsal lobe. In outline, suture and position of siphon, it resembles the form of *Nautilus Bohemicus* of the Silurian, until it attains a much older period. The second septum has the dorsal lobe and is otherwise changed, and this is the representative of the first septum in *Nautilus pompilius*.

The first septum of *Nautilus Koninckii* of the Carboniferous differs but little from the succeeding septa, except in being shallower. It is very shallow, and has nearly the same outlines as the first septum of *Nautilus atratus* or *lineatus*. The septa of *Nautilus Bohemicus*, until a much later period, possess apparently similar shallow ventral and abdominal cells, though in the adult these become too deep for comparison. The evidence is sufficient, however, to show that the first ten or twelve septa of *Nautilus Bohemicus* of the Silurian, and the earlier septa of *Nautilus Koninckii* of the Carboniferous, are all represented by one stage of growth in one septum in *Nautilus atratus* of the Jura; then that this stage is skipped, or left out entirely in *Nautilus pompilius* of the present epoch. This is the law of acceleration, or the perpetual reduction of adult characteristics to earlier and earlier periods in the growth of the later existing individuals, until finally many characteristics altogether disappear. The shell of Ammonites, Goniatites, and Nautilus is composed of two layers, the external layer being separable into two strata, an outer colored stratum and an inner whiter stratum. All of these are imbricated so as to show that they are undoubtedly made up of zones of growth laid on from within by the edge of the mantle.

[1] This scar is the real apex of the whorl, not the apparent apex, but lies on the dorsal side of the angular termination of the whorl.

The layers of the shell do not extend around the whorl in Ammonites, being wholly absent from the dorsal side. In Nautilus, however, they do encompass the whorl, though the outer layer is very thin on the dorsal side. The shell encompasses the ovisac in Ammonites and Goniatites, but is very thin on the dorsal side of the embryo, and very thick on the sides and abdomen. This at first led me to suspect that the whole shell was deposited by the arms, as suggested by Valenciennes, with regard to the deposition of the colored stratum.

But the structure of the shell in the walls of the ovisac is like that of the adult, and shows that it, too, was deposited from within. All the tetrabranchiate Cephalopods, therefore, are likely to prove to be animals either wholly, or to a large extent, included in their shelly coverings.

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## INTERMEMBRAL HOMOLOGIES. BY BURT G. WILDER, M.D.

*Continued from p. 389.*

### VI. SPECIAL PROBLEMS.

Since it is probable that the telical antagonism of the membra with some mammals must be eliminated from the discussion of their morphical relations; and since the latest views upon the subject are based upon the primitive condition and position of the membra in the embryo; and since they then do not indicate either syntropy or antitropy, but are capable of interpretation upon either hypothesis; and since, finally, their adult condition points toward syntropy rather than antitropy, so that the majority of anatomists are inclined to regard that as their true and morphical relation; it is evident that we must not merely remove the obvious objections to our way of thinking, but must produce some positive evidence in its favor.

This evidence consists in the establishment of the following propositions.

1. The cephalic and caudal regions[1] of the body are comparable with each other as are the right and left sides.

[1] The term region must here be taken to include all in front of, or behind, a middle point, and not merely the head or the tail.

2. The armus and skelos are appendages of the cephalic and caudal regions respectively.

Whence it follows that the armus is comparable with the skelos as the two armi or the two skelea are comparable with each other.

### CEPHALICO-CAUDAL HOMOLOGY.

The evidence in favor of the first proposition is admirably stated by Wyman, 55,249 ; but I think we must eliminate what he regards as "the most striking facts bearing upon the idea of fore-and-hind symmetry," the antagonistic attitude which the *membra* assume during the *third* stage of development, (55,252.); since the syntropists would say that this attitude is only secondary and adaptive with the mammalia, and does not even occur at all with lower vertebrates.

As to the *trunk*, we quote Wyman's statements as follows :

"First. The embryo increases in size, not by a growth from before backward, but from a central, and, as it were, neutral point, both backward and forward, so that the two ends are made to recede from each other in opposite directions."

To this it may be objected, that with the turtle (Agassiz, 200, 2, 539 and 543), and probably with most vertebrates, the cephalic fold is *first formed;* and retains throughout a prominence by which it is distinguishable from the caudal fold; but on the other hand we may say, that the turtle is from the beginning a *cephalized* organism, and all its development must have reference to the after existence of a prominent head, so that this priority in appearance of a cephalic over a caudal part is purely telical and no bar to a morphical comparison. I am inclined to doubt whether this objection could arise with Amphioxus.

"Second. The primitive groove of the nervous axis in its earliest stage is nearly symmetrically enlarged at either end, so as to form two opposite dilatations ; one the precursor of the future cerebral vesicles, the other of the rhomboidal sinus."

"Third. When the spinal groove closes up, it does so, as Reichert has shown, by the union of its lips, first in the middle portion, and then gradually in a symmetrical manner towards either end."

To the above it will perhaps be answered that with turtles, (200, 544, and 546), the primitive furrow appears first nearer the cephalic fold, and its closure also begins in that region ; but it is probable that

both these differences are explicable like the preceding, and that they would not exist in the Amphioxus.

"Fourth. The first traces of vertebral segments are to be found in three or four pairs of plates, which appear on either side of the primitive axis, midway between the two ends; the ossification of the bodies of the vertebræ takes place in the same order, beginning in the middle and extending in either direction."

Upon this point Dr. Cleland has written me as follows: "Remak is quite explicit in the statement that the primordial vertebræ are developed *from before backward;* it is quite true that the first three or four which appear, are placed about the middle of the embryo, but that is because the cephalic part of the embryo forms so large a portion of the whole." May 7th, 1868. Upon this I cannot give an opinion, because it is not yet determined where the middle point of the vertebrate embryo lies; indeed, it *seems* to shift position from stage to stage of growth. Agassiz's statements respecting the turtle agree with Wyman's, but if we exclude the head from the length, then the first vertebræ appear to be formed in the neck; and I have observed that in a large adult skate, *Raia ocellata*, the segmentation of the vertebral column appears at some distance behind the occiput, and increases *gradually* toward the middle of the length.

Bischoff's figures, especially in the paper on Kaninchen-Eies (figs. 53 and 54), indicate that the primitive vertebræ begin at some distance behind the cerebral vesicles; but Huxley (78, 11) states that the protovertebræ commence at the *anterior* part of the cervical region and gradually increase *backward.* The matter can only be decided by observations made with the present doubt in view.

But for this as for the previous questions, I believe we must look to Amphioxus.

I quote further from Cleland's letter. "A strong point against primitive antero-posterior symmetry, is found in the construction of the vertebræ; the body of each vertebra, according to Remak, is originally formed, the anterior half from one primordial vertebra, the posterior from another; you have these two parts seen in the shape of two cones placed apex to apex, and if there were primitive symmetry, surely, when the arch and ribs are in connection with the anterior cone in the anterior vertebræ, they ought to spring from the posterior cone in the posterior vertebræ; but it is not so; they always, I believe in all vertebrates, come from the anterior half; . . . . the nerves also, lie *behind* the arches and ribs of the permanent vertebræ,

throughout the spinal column." It is evident that these are fair objections, and I call upon others to aid in their removal.

But in my opinion, the most conclusive evidenee of a meketropic homology between cephalic and caudal regions, lies in the fact that in the very earliest stages of the vertebrate embryo, no difference whatever can be detected between them; the primitive disk is circular, and homogeneous, and, in the turtle at least (200, 2, 536), the very first step toward the formation of organs is the depression of the surface at two points upon opposite sides, which mark the position of the future head and tail; the primitive furrow appears later; so that if development is given the importance which most now allow it, we can say that the two ends of the body are set off against each other, as homologous and antagonistic parts, even before the right and left sides are separated by the primitive furrow; moreover, at this time, the head and tail are nearer each other than the right and left borders of the embryonic disk, and the subsequent elongation and narrowing is adaptive and not of morphical importance.

Prof. Wyman's fifth kind of evidence embraces the facts of resemblance between the organs at the oral and the anal outlets of the alimentary canal, which was first alluded to by Oken; but it is probable that all determinations of the softer parts must wait until those of the bones are satisfactorily made out. When, however, they are taken up, it ought to be ascertained whether the reversed relative position of the urinary to the intestinal orifices in *Teleostei* as compared with other vertebrates, affects the homology of the parts, or whether it may be regarded as comparable to the differences in the connection of the pneumatic duct of *Lepidosteus* and *Erythrinus*, (Ow. 63, 1, 494), as compared with *Lepidosiren* and the true air-breathing vertebrates.

## THE "NATURE OF LIMBS."

Can we now demonstrate the second proposition, that the armi are appendages of the cephalic region of the trunk, and the skelea of the caudal region, and thus find reason for regarding them as similarly related?

The "Nature of Limbs" has been very differently interpreted, and the minor problems involved in the general question are many and complex.

1. What is the normal number of membra?

[1] See Hunter's Anat. Memoirs, edited by Owen, vol. 1, p. 198.

If we could confine ourselves to the adult *Mammalia*, the answer to this would be easy, for no member of this class is known to possess more than two pair of organs which answer to the common idea of "limbs"; the same is true with the reptiles, the birds, and the amphibia, but if we include the fishes, there is room for difference of opinion.

Huxley (251, 61,) and Rolleston, (284, XXXII), state that there are only two pair of "articulated limbs;" and this is the opinion of nearly all anatomists; but Parker, (292, 3), seems to include the ordinary membra in the same category with the median fins; Humphrey, (248, 65,) is more explicit and holds that "each limb of the higher animals corresponds with a lateral factor or factors of the mesial fin of the fish and would, if development had proceeded in a similar manner, have united with its fellow into a mesial organ." Cleland (65), advances the view that "the suspensorium and lower jaw form an arch corresponding with the limb arches, and the opercular apparatus of fishes consists of appendages attached to it;" while Owen (20, 333 and 63, 1, 102), not only includes under the general title of "diverging appendages," the pectoral and ventral fins (or "limbs"), the "branchiostegals," the "operculars" and the "pterygoids," but also (20, 269; 63, 1, 30, and 63, 2, 18) enumerates therewith the slender or flat processes projecting backward from the ribs in some fishes, crocodiles and birds; and further adds that "the true insight into the general homology of limbs leads us to recognize many potential pairs in the typical endo-skeleton," (20, 270).

Now it must be admitted that the facts of development as at present understood, are not wholly opposed to the above views of the "general homology of limbs"; and Wyman, after a most admirable exposition of the case (55, 264) says "we believe there is ground for the hypothesis that limbs belong to the category of tegumentary organs."[1] But it ought also to be considered that this conclusion is based chiefly upon the *apparent identity of the membral buds with the ridges which afterward give rise to the median fins;* and this involves the great question of the relative value of *development* and of *position* for the determination of homologies; in the present case, if we allow that the homology between the median and the lateral appendages of fishes is as complete as that between the two pairs of lateral appendages themselves, upon the ground of primitive identity of structure, then must

[1] Oken, (285, Par. 3387), called them "tegumentary members."

we not likewise conclude that the visceral arches are membra joined on the middle line; that the flukes of cetacea are membra; that the lateral ridges at the root of the tail in some selachians are also membra; and finally that the carapax of tortoises, (Agassiz, 200, 2, 562,) represents a continuous series of *undistinguishable* membra above the ordinary pairs; this is almost a *reductio ad absurdum*, and is to my mind sufficient evidence that in this connection at least, relative position is of greater importance than apparent identity of primitive structure; and that we are entitled to recognize in the vertebrate only two pairs of real membra.

There is one other fact which serves to distinguish the membra from the median fins; the latter always appear as a continuous dorsal and ventral ridge, which may persist in some fishes and batrachians, but which is generally absorbed at intervals so as to leave certain portions to form the permanent fins; now if the membra were wholly in the same category with these median fins, why should they not be formed in like manner? The fact is that they never are so formed, even in the skate, where, as shown by Wyman (317, p. 35 and Fig. 4), the pectoral and ventral fins commence as slight ridges in the same plane and in close juxtaposition, yet *not continuous* with each other.

Nevertheless the opinions of the above-mentioned authorities are entitled to great respect, and it can hardly be assumed that the question as to the number of membra is decided; indeed, perhaps a recognition of three or more "potential pairs of limbs" is not necessarily incompatible with the idea of a meketropic relation between the armus and skelos, which all agree to be homologous in some way ; but it is evident that such a conception as Owen's archetype skeleton, (63, 1, 80), in which the diverging appendages all point backward, could not co-exist with a distinct idea of meketropy; and neither he nor Cleland, nor Humphrey, nor Parker have ever admitted such a principle of organization so far as the skeleton is concerned ; it is manifestly more easy to regard the membra as themselves antitropically related if we can show that there are but two pairs, the one belonging to the cephalic the other to the caudal half of the trunk, as seen in Fig. 4.

The early and enormous increase of the head in the higher vertebrates leaves the armal buds at about the middle of the embryo; the balance is only restored when a long tail is formed at the other end; in either case the armi would seem to be most intimately connected with the cervical region, and the skelea with the lumbar; but here

arises the question as to the relative value of nervous and osseous associations.

The previous question suggests several others which have already been much discussed.

1. What is the morphical relation between the membra and the omozone and ischizone?

2. What is the morphical relation between these arches themselves and the skeletal axis?

3. What relation do these arches hold to each other?

It is now generally admitted that the scapula and ilium are not properly parts of the membra, although the former, especially, appears to be such in many quadrupeds, which lack the other elements of the omozone; and although the telical antagonism of position between scapula and ilium has led me to include these bones in the presentation of evidence (45, 20,): but I am now convinced that this, like some other considerations (the convergence of the dorsal spines toward the centre of motion, and the antagonism of membral internodes), must be eliminated from the discussion.

The relation between the membra and the membral arches has been ably discussed by Humphrey, (36, 23); also by Wyman, (55, 264), who concludes that "in their primary condition, limbs do not appear to be dependencies of the scapular and pelvic arches any more than . . . . . the teeth are dependencies of the jaws, with which, notwithstanding their totally different origin they become so intimately united at last." Still, and in spite of the probability that the omozone serves, especially with fishes, as a heart protector, there seems no reason to doubt that both omozone and ischizone are formed with reference to the attachment of the membra, and are shifted in position in conformity with the needs of different species. Upon this point consult also Coues, (70, 194, note).

This leads to the second question as to the morphical relation between the omozone and ischizone and the rest of the skeleton.

The view of Owen that the "scapular arch is normally the haemal arch of the posterior occipital vertebra of the skull" has been endorsed by no real investigator of the subject,[1] and has on the contrary been vigorously combated by Goodsir, (240, 199,) Humphrey. (36, 26), Agassiz, Wyman, (55, 260) Spencer, (299, 522) and Parker, (292, 87); like some other views of the eminent English anatomist, this must be regarded as a motion unseconded, and therefore not open to debate. Upon this question consult Parker, (292), Cleland (65,)

and Wyman (55, 260,) who think that "additional evidence, especially from embryology, is needed before definite conclusions can be reached."

Embryology ought to determine whether the forward transfer of the ventrals to beneath or even in front of the pectorals, in some *Malacopteri*, is a real shifting or only an ideal one, and if the former, how it is accomplished; for evidently our second proposition will not be accepted by the "realists" in anatomy so long as the "legs" are in front of the "arms" with any vertebrate, unless a sufficient account can be given of the matter, enabling us to adduce the somewhat similar displacement of the eye in the *Pleuronectidæ*, which, by the way, could be made to serve in the elucidation of both problems, since Traquair's researches are not so complete as might be wished.

As to the third question, there seems to be no dispute that the omozone and ischizone do, in some way correspond; but both Wyman and Humphrey, who have most ably discussed it, will now doubtless admit that no determination of the special homologies of the constituent bones can be other than provisional until the development of the ischizone has been elucidated as completely as that of the omozone has by Parker; and even then, we must know whether these bones are to be compared syntropically or antitropically; the importance of such determinations is obvious on account of the great number of muscles which arise from the two arches.

We have now to inquire whether the foregoing considerations justify our acceptance of the proposition that the armus and skelos are respectively appendages of the cephalic and caudal regions of the trunk; it seems to me that they do justify us in accepting it provisionally, and until it is satisfactorily shown, first, that there are more than two pairs of membra, actual or potential, and second, that no such thing as antitropy exists in the body itself. Till then, I think we are entitled to study the membra as if they might be proved to be antitropically related, and to regard our success in such comparison as presumptive evidence of the correctness of our method.

### MEMBRAL OSTEOGENESIS.

If, as is held by Darwin and others, the morphical value of a character is inversely to its apparent telical importance, I think a very

[1] Prof. Dana has in a letter to me stated that he now regards the relation of the arms to the head as a functional one, not a structural, as admitted in 217, 341; and I here beg to withdraw my own acceptance of what Parker calls the "peripatetic morphology of the shoulder-girdle."

strong argument in favor of the antitropic relation of the membra may be derived from the manner of their ossification as described and figured by Robin.[1]

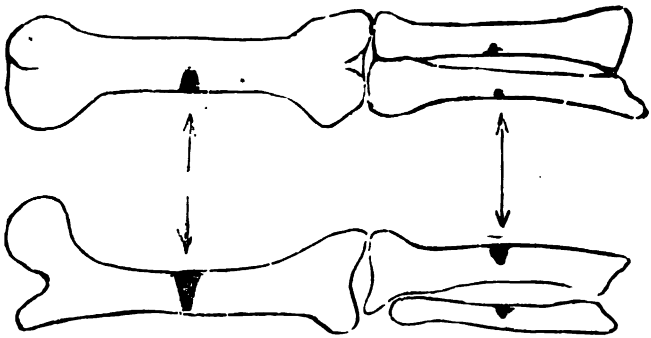

Fig. 5.

I have copied his figures, reversing one of them in order to show the membra in the relative position which they would have when attached to the body, the inside borders (post-armal and pre-skeleal) facing each other. It appears from both the figure and description of Robin, (though he evidently attached no such significance to the fact, and this gives it the greater value for us,) that the long bones of both membra begin to ossify in a strictly antitropic manner, the very shapes of the points of ossification being symmetrically related. If this is the rule with the mammalia, I shall look upon it as a most decided confirmation of the general views advocated in this paper, and would call the attention of embryologists to the statements of Robin, which I have no means of verifying at the present time.

[1] Sur les conditions de l'osteogenié avec ou sans cartilage prexistant; Journ. de l'Anatomie, Tom. 1, 1864, p. 577, Pl. xv.

REMARK.

The delay in the publication of the last part of this paper enables me to offer some general remarks upon it in place of the Glossary of morphological terms, the announcement of which was inserted during publication, but which for various reasons I have concluded to omit.

The chief of these reasons is a doubt of my ability to do the work satisfactorily at this time; but to this are added the doubt as to the limits of such a glossary, and the hope that the new nomenclature herein proposed may find helpful criticism among my morphological brethren. Yet even were every new term refused acceptance, my own conviction of the urgent need for a reform in our system would be in no way shaken. At present we are trying to do good work with most imperfect instruments; for we are trying to tell each other about the parts of animals and their relations to each other (these appearing daily more numerous and complex), in the language of popular science; we are, in fact, discussing these matters in a manner nearly as loose and inexact as that in which animals and plants were described prior to the reform begun by Linnæus.

The various problems which are involved in the general question of intermembral homologies, are rather indicated than discussed; the solution of some requires new information upon *facts*; but it seems to me that a more urgent need is some agreement as to the *value* of different kinds of evidence; together with a logical method in its application. In view of these necessities I venture to suggest the incorporation of systematic instruction upon "logic" and "evidence" into all University Courses in Natural History. I am certain that had logical and legal methods of thought been followed, the acceptance of the symmetrical relation of the membra never would have been hindered by a purely popular superstition, like the correspondence of thumb and great toe; and I claim to have proved in the foregoing pages that the agreement or disagreement of parts in *numerical composition* has never been held to invalidate any homology based upon *relative position* or *mode of development*. Yet even in this section of my paper merely an outline of the evidence and argument is given, and I have to thank my friend Dr. Coues for a forcible amplification of certain points. I may here refer to the intention formed ten years ago, and expressed at the beginning of this paper, to make the elucidation of intermembral homologies a main object through life, and to offer from time to time papers upon the special problems

involved. One word as to the historical sketch; I can hardly hope to have done justice to all; especially to those whose works have not been directly accessible; but while the diagrammatic arrangement of the authors will make my errors more apparent, it will also enable every one to find or alter his own proper place, or that of another upon the scheme.

Finally I beg that the whole paper may be viewed as a "topography of our ignorance," and as an effort to map out our future work, rather than as an *ad captandum* attempt to decide the great questions herein presented.

## ADDENDA.

*Page* 161. It is worth noting that the great work of Bourgery and Jacob contains the following suggestion to a symmetrical comparison of the membra, which, however, like many another, fell still-born; "En resume, l'epaule n'est autre chose que le bassin renverse." Anat. de l'homme, tom i, p. 107.

*Page* 169. I trust that the new technical terms here proposed will not be included by the Rev. J. G. Wood in his reference to the "Cacophonic combinations of syllables" (Ill. Nat. Hist. of Birds, p. 178). Yet his general criticism upon scientific nomenclature is well merited; and would only perhaps be more useful if coming from one whose style was less diffuse than that of the above-mentioned popular writer.

*Page* 173. Synonyms of Annularis; from Huxley, 78; *Ulnar finger*, p. 266, *Ulnar digit*, p. 270; *Fourth digit*, p. 269.

*Page* 311. As to the morphical value of numerical composition Mivart says, "I think the degree of segmentation of such structures (ribs) of very little consequence morphologically." Vertebrate skeleton, p. 374.

*Page* 326. The phrase "morphological value" occurs in Wyman's paper on the Development of Raia batis, 337, 85.

*Page* 328. As to establishing different kinds of groups upon certain organs, Agassiz says, "No system can be true to Nature which is based upon the consideration of a single part, or a single organ"; 201, 289. And Alfred Newton, in reviewing Huxley's new classification of *Aves*, speaks as follows: "It does seem a question very much deserving of attention, how far any approach to a natural system can be based upon the modifications of one part of an animal's structure, without any reference whatever to other portions of it." Zoolog. Record, 1867, p. 48.

*Page* 330. Agassiz intimates that orders are based upon *internal* structure, in contradistinction to form upon which families are founded; 201, 213.

*Page* 332. I greatly regret that Kowalewsky's researches upon the development of Amphioxus were not accessible to me when this paper was written: the little creature is a good illustration of the contrast between teleological

importance and morphological value, for I believe it will prove more useful than all other vertebrates together, in deciding the problems indicated in this paper.

*Page* 337. For representation in fibrous tissue by adult structures of what was cartilaginous in the embryo, see Parker (292, 162 and 197).

*Page* 338. As to the morphical value of development, the two great English authorities differ further, as follows: Owen (63, 3, 742) speaks of the "low taxonomic value of the placental character"; "development is no ground of homology or homotypy"; while his general repudiation of the criterion is vigorously expressed as follows: "Whenever a false homology has to be maintained, the earliest and obscurest phenomena and embryonal development are usually resorted to in support of such view" (63, 3, 146, note 5). While Huxley, on the other hand, states that "an extensive study of the integumentary organs convinces one at once that mere structure affords no base for homology; . . . these definitions of ecderon and enderon rest wholly upon the mode of growth." Cyc. Anat. and Phys.; suppl., p. 476.

## VII. CHRONOLOGICAL LIST OF SPECIAL WORKS AND PAPERS UPON INTERMEMBRAL HOMOLOGIES.[1]

1. VICQ D'AZYR: Memoire sur les rapports qui se trouvent entre les usages et la structure des quatre extrémités dans l'homme et dans les animaux. Mémoires de l'Académie royale des sciences, 1774, p. 254. (Reprinted in Œuvres recueillies par Moreau, 1805; tom. iv, p. 315.)

2. WINSLOW, J. B.: Exposition anatomique de la structure du corps humain, nouvelle édition, 1775. (First edition, 1732; second, 1763.)

3. ISENFLAMME ET FERLYBOLLES: Dissertation des extrémités —— —— Erlangen, 1785.

4. CHAUSSIER: Exposition des Muscles, 1789.

5. SŒMMERING: De corporis humani fabrica, 1794.

6. CUVIER: Leçons de l'Anatomie comparée, 1800; tom. i, p. 430. (2d ed. 1832.)

7. Handbuch der menschlichen Anatomie, 1816. (See also the French and English editions.)

8. DE BLAINVILLE: Nouveau dictionnaire d'histoire naturelle de Deterville, 1818; tom. xix, p. 91. (See also his Ostéographie *Primates*, tom. i, p. 26, 1841; and a citation upon the Muscles in the Appendix to Meckel's Traité d'anat. comp., tom. vi, p. 494.)

9. BARCLAY: The bones of the human body represented in a series of engravings; explanation of plate XXIV, 1824.

10. GERDY: Note sur le parallèle des os; Bulletin Univ. de Férussac, Sciences Médicales, tom. xix, 1829.

11. DUGES: Sur la conformité organique de l'echelle animale; Ann. des Sci. Nat., 1831. (Printed separately, 1832.)

[1] An asterisk indicates that the work is in the possession of the writer. For others he would be glad to exchange copies of the present and previous papers.

12. BOURGERY (ET JACOB): Traité complet de l'anatomie de l'homme; tom. i, pp. 132–135, 1832.

13. BLANDIN: Nouveaux éléments d'anatomie descriptive, 1838.

14. FLOURENS: Nouvelles observations sur le parallèle des extrémités dans l'homme et les quadrupèdes; Ann. des Sciences Nat., 1838; the same in Memoires d'Anat. et de Phys. Comp., 1844. (With plates.)

15. RICHAUD: Sur l'homologie des membres supérieures et inférieures de l'homme; Comptes rendus, tom. xxix, p. 130, 1840.

16. BERGMANN: Vergl. des Unterschenkels mit dem Vorderarm; Müller's Archiv für Anatomie, 1841.

17. BUDD: On diseases which effect corresponding parts of the body in a symmetrical manner; Med. Chi. Trans., Vol. xxv, 1841.

17½. PAGET: On the relation between symmetry and the diseases of the body; Med. Chi. Trans., Vol. xxv, 1841.

18. CRUVEILHIER: Parallèle des membres thoraçiques et des membres abdominaux; Anat. desc., tom. i, p. 840, 1843.

19. STRAUSS-DURCKHEIM: Traité d'Anat. Comp., 1843, pp. 281, 282.

20. OWEN: On the archetype and homologies of the vertebrate skeleton; Rep. of Brit. Ass. for Adv. of Science, 1846; pp, 169–340. (Many figures.)

21. AUZIAS TURENNE: Sur les analogies des membres supérieures avec les inférieures; Comptes rendus de l'Acad. des Sciences, 1846; tom. xxiii, p. 1148.

22. MACLISE, JOSEPH: Comparative osteology and the archetype skeleton; 1847. (With plates.)

23. *MACLISE: Article SKELETON; Todd's Cyclopedia of Anatomy and Physiology, 1849.

24. *JONES, T. R.: Article OSSEOUS SYSTEM; Cyc. of Anat. and Phys., 1847.

25. RIGAUD: Sur l'homologie des membres supérieures et inférieures de l'homme; Comptes rendus de l'Acad. des Sciences, 1849, p. 630; the same, Revue et Magasin de Zoölogie, 1849, p. 564.

26. *AGASSIZ and GOULD: Principles of Zoölogy, 1851.

27. GERVAIS: Sur la comparison des membres chez les animaux vertébrés; Ann. des Sciences Naturelles, 1853.

28. JOLY ET LAVOCAT: Etudes d'Anatomie philosophique sur le pied et la main de l'homme, remenés au type pentadactyle; Mémoires de l'Académie de Toulouse, 1853. (See 31.)

29. PFEIFFER, HERMANN: Zur Vergleich. Anat. des Schultergerüstes. Geissen, 1854.

30. CHAUVEAU: Traité d'Anatomie des animaux domestiques, 1857.

31. JOLY ET LAVOCAT: —— ——; Comptes rendus, tom. xxxv, 1852, p. 838; 1853, p. 1242; 1857, p. 1223. (see 28).

32. FICK, LUDWIG: Hand und Fuss; Archiv für Anatomie, 1857, pp. 435–458.

33. *MARTINS, CHARLES: Nouvelle comparison des membres pelviens et thoraciques; Memoires de l'Academie des Sciences et des lettres de Montpellier, 1857; Annales des Sciences Nat., 1857. (The above is reviewed in the Journal de la Physiologie, 1858, p. 812.) (See 53).

34. *HUMPHREY, GEO. M.: A treatise on the human skeleton, p. 600, 1858.

35. *Wyman, Jeffries: On anterior and posterior symmetry in the limbs of mammals; Proc. Boston Soc. Nat. History, June 6th, 1860.

36. *Humphrey: Observations on the limbs of Vertebrate Animals; Communication to the Cambridge Philosophical Society; 4to, pp. 44. With plates.

37. *Martins: Ostéologie comparée des articulations du coude et du genou; Mems. de l'Acad. des Sciences de Montpellier, 1857; Untersuchungen zur Naturlehre des Menschen und der Thiere von Moleschott, vol. VI, 1860; Ann. des Sciences Nat., 1862.

38. *Wilder, Burt G.: Contributions to the Comparative Myology of the Chimpanzee; Boston Journal of Natural History, Vol. VII, pp. 853–884, p. 362, 1861.

39. *Foltz: Homologie des membres pelviens et thoraciques de l'homme; Journal de la Physiologie, 1863, pp. 40–81, 379–421. (With plates.)

40. Folsom, Norton: Anatomical Symmetry; a thesis read at his graduation in the Harvard Medical School, Boston, Mass., March, 1864. (Not printed.)

41. Gegenbauer, Carl: Untersuchungen zur Vergleichenden Anatomie der Wirbelthiere; erstes Heft (Carpus und Tarsus); Leipzig, 1864; mit sechs tafeln.

42. Huxley, T. H.: On the limbs of Vertebrates; a lecture before the Royal Coll. of Surgeons of London, Feb. 6th, 1864; an abstract in Medical Times and Gazette, Feb. 20th, 1864.

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44. Paget: Surgical Pathology; 3d Am. ed., 1865, p. 35.

45. Wilder: On morphology and teleology, especially in the limbs of Mammalia; Memoirs Bost. Soc. Nat. Hist., Vol. I, No. I, p. 35.

46. Mivart, St. George: On some points in the anatomy of Echidna hystrix, and on the serial homology of the limbs; Trans. Linn. Soc., Vol. XXV, 1866; pp. 379–403; with plates.

47. Cleland, John: Comparison of the upper with the lower limbs; Quain's Anatomy, 7th ed., 1866, p. 115.

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54. Pagenstecher: Ein Vergleich der Muskulatur des Drill mit der des Menschen; der zoologische Garten; Zeitschrift für Beobachtung Pflege und Zucht der Thiere. April and May, 1867.

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64. HUMPHREY: Disposition and homologies of flexor muscles of leg and forearm (Journ. of Anat. and Phys. May 69, pp. 320–334).

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67. *WILDER: Fingers and Toes. Hours at Home. October, 1870.

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72. HUMPHREY: Comparison of shoulder-bones and muscles with pelvic bones and muscles; Journ. of Anat. and Phys., Nov., 1870, p. 67: plate.

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74. *WILDER: Review of Coues on antero-posterior symmetry (70); American Naturalist, April, 1871; (the same in more extended form, Am. Journ. of Science, July, 1871).

75. *COUES: On the myology of the Ornithorhynchus; communications to the Essex Institute, Vol. VI, pp. 127–178, March, 1871; (published May, 1871).

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203. *AGASSIZ: The Catagories of Analogy. (Essay on Classification. Ch. ii. Sect. IX.) London, 1859. (This subject is not directly discussed in 200.)

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205. *BARCLAY: Anatomical nomenclature; cited by Owen. 63, 2, 68, note.

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208. BRAUN: Sur les transformations de l'ovule vegetale. Ann. des Sc. Nat. 1860.

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212 *CLELAND: On the Vomer in man and the Mammalia, and on the sphenoidal spongy bones. Edinburgh New Phil. Journal, January, 1861.

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221. *DARWIN: The variation of animals and plants under domestication. (Am. ed.) N. Y. 1868. 2 vols.

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224. DU PIU: De homine dextro et sinistro. Leyden, 1790.

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[1] An apology is due for the inaccuracies, omissions and occasional inconsistencies of the foregoing list of works. The latter defect is mainly the result of my desire to avail myself of the numerical designation of many works before the list was completed; a partial remedy for the others will be the reception of the papers not herein marked as already in my possession.

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